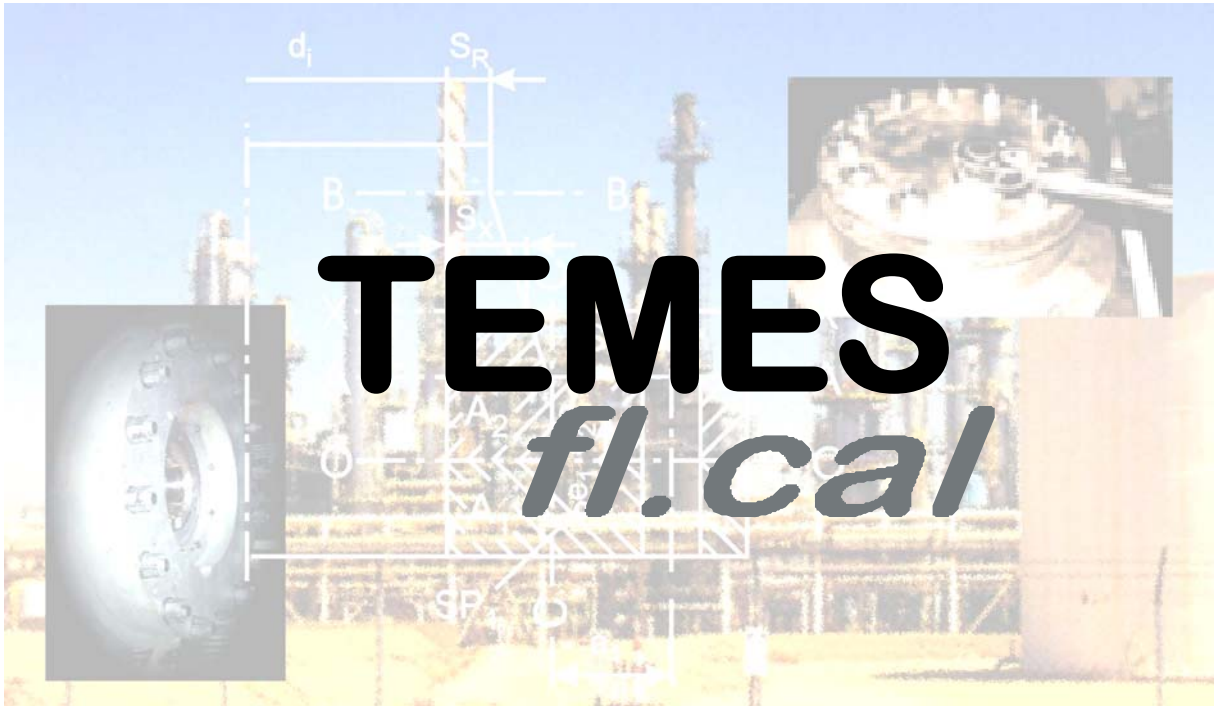
User Manual



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1 Introduction

The software **TEMES*fl.cal*** is used for flange calculations based on EN 1591-1 (April 2001 Amendment A1, amended May 2007)

The ASME calculation procedure is integrated into the next stage of development in the software.

The EN 1591-1 is a European calculation rule for the design of circular flanges and gaskets. It considers the whole system of flange, bolt and gasket under the criteria of strength and tightness.

2 Installing the software TEMES*fl.cal*

The software **TEMES*fl.cal*** is a program developed for Windows platforms. In order to achieve good display quality and an acceptable processing speed, the following minimum hardware requirements are essential:

- Pentium III with 500 MHz
- 128 MB RAM
- VGA Display (resolution 800 x 600)
- Windows 8, 7, XP or Windows Server 2008, 2003
- 20 MB hard disk space
- 1 free USB port for the dongle

2.1 Software protection

The software **TEMES*fl.cal*** is protected against unauthorized copying. For this purpose the software is delivered with a USB dongle called “Sentinel SuperPro key”. The software can be executed only when this dongle exists on the system on which it is installed.

The software **TEMES*fl.cal*** is therefore installed in several steps, in the following order:

1. Install the software
2. Install the software for the dongle
3. Insert the dongle
4. Setup links and shortcuts on the client computers to the software installed on the host computer (only network version)

2.2 Installing a single user version

Insert the CD into the CD-ROM drive of the PC where the software is to be installed. The installer will start automatically. If the autorun option is disabled on your PC, go to the Windows Start menu, click "Start" and subsequently "Run", enter "X:\setup.exe" in the command line (where X is the name of the CD-ROM drive of your computer) and confirm with "OK".

Follow the instructions during the installation process. After installation is complete you will receive information about whether the program was successfully installed.

Then install the software for the dongle. This must be done in all cases before inserting the USB dongle. Therefore you need to start the installation program **“Installation of Sentinel Super Pro key driver”** (or run “X:\SuperProNet Combo Installer\setup.exe" from the installation CD).

Finally, you can insert the USB dongle.

The software is now ready for use, as long as the dongle on the associated USB port is found.

2.3 Installing a network version

The **TEMES*fl.cal*** software can be installed directly on the network server or on a local computer, which serves as a file server. The following description is therefore generally referred to a server.

Insert the CD into the CD-ROM drive of an arbitrary client PC with access to the server or in the CD drive of the server. It is necessary to have write permissions on the destination drive of the server to install the software. The installer will start automatically. If the autorun option is disabled on your PC, go to the Windows Start menu, click "Start" and subsequently to "Run", enter "X:\setup.exe" in the command line (where X is the name of the CD-ROM drive your computer) and confirm with "OK". Enter the installation drive and directory on the server

Follow the instructions during the installation process. After installation is complete you will receive information about whether the program was successfully installed. The installation directory of the software must be shared on the network, so that this can be accessed by other workstations.

Then you can install the software for the dongle. This must be done in all cases before the insertion of the USB dongle itself. The software installation for the dongle must be done on the server. For this you need to start the installation programm **“Installation of Sentinel Super Pro key driver”** (or run “X:\SuperProNet Combo Installer\setup.exe" from the installation CD).

Now you can install the USB dongle on the corresponding port of the server.

Finally, relevant links from the client machines need to be established with the software on the host computer. For this purpose click to the desktop with the right mouse button and select "New" and "Shortcut". With the "**Browse**" button you can select the installation directory of the software and the file "**TEMESflcal.exe**"

At first start of the software, the user must have local administrator rights because the file **"sx32w.dll"** is copied from the server to the local machine into the directory **"system32".**

The software can be now started from the individual workstations if the host computer is running and the installation directory is shared. The number of users that can run the program in parallel is limited to the number of licenses purchased.

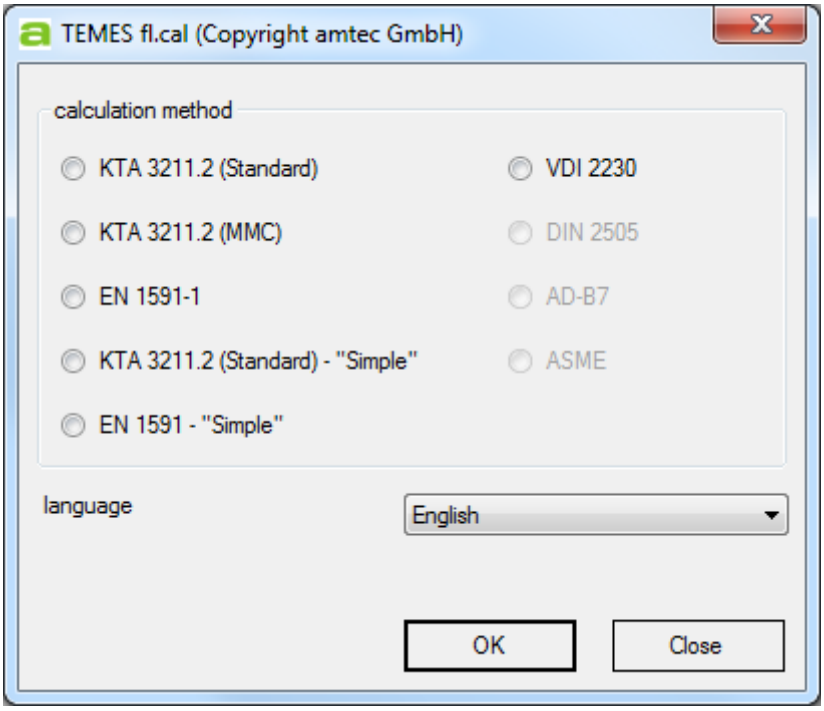
2.4 Uninstalling the software TEMES*fl.cal*

During the installation of the software **TEMES*fl.cal*** an uninstaller was created on your PC which can help you to uninstall the software. Follow the instructions shown after starting the uninstaller. For the case of a network version the links need to be deleted manually on the individual workstations.

3 Software TEMES*fl.cal*

3.1 Program start

After starting the software **TEMES*fl.cal*** a menu window pops up where the calculation method and the language are selected. Click “OK” to load the corresponding calculation module and user interface in the selected language.



Choices are:

- KTA 3211.2 (KHS): Calculation of a main load seal flange connection based on KTA 3211.2 rules;

- KTA 3211.2 (KNS): Calculation of a force shunt flange connection based on KTA 3211.2 rules;
- EN 1591: Calculation of a flanged connection based on EN 1591-rules.

For display, input and output the languages German and English can be chosen.

The description of the user interface and the results in this manual is for the following calculation methods:

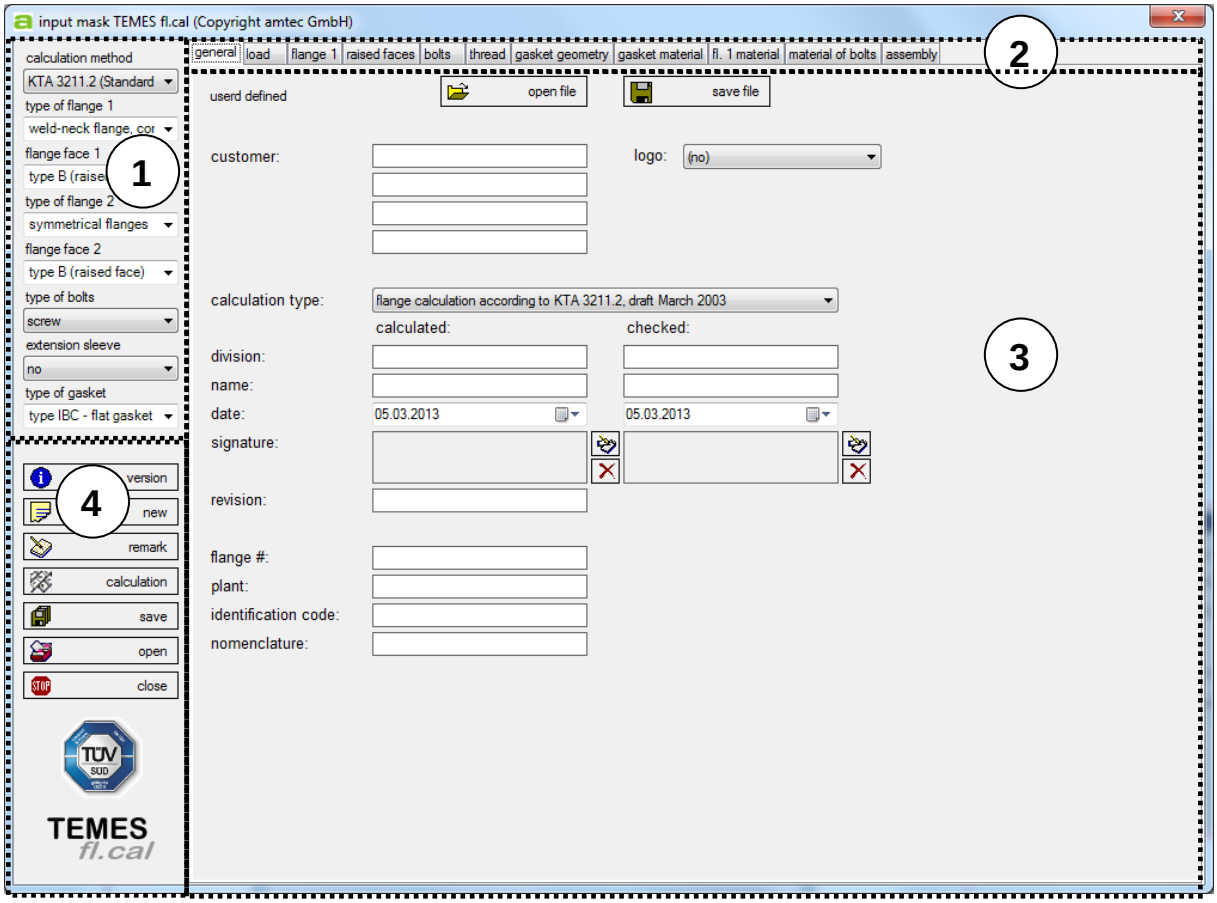
- EN 1591: in sections 3.4 and 3.5.

In the following section 3.2 the main page of the TEMES*fl.cal* - user interface will be described.

3.2 TEMES$_{fl.cal}$ input window – general information

The user interface of the **TEMES$_{fl.cal}$** – software is arranged in four areas:

- Presets (1)
- Selection of input masks (2)
- Input fields of the selected input masks (3)
- File management (4).



In the upper part of the left panel (area 1), the geometric designs of the flanges, the bolts, the expansion sleeves and the seal of the selected method are defined:

Calculation methods: At the moment KTA 3211.2 (Standard), KTA 3211.2 (MMC) and EN 1591 are available.

The following list shows all parameters for the EN 1591 calculation method:

- **Flange type 1:**
  - Loose flange conical neck
  - Loose flange cylindrical 1
  - Loose flange cylindrical 2
  - Hubbed threaded flange
  - Weld-neck flange, conical shell 1
  - Weld-neck flange, conical shell 2
  - Weld-neck flange, conical shell 3
  - Slip-on-welding flange with neck
  - Weld-on plate flange
  - Weld-neck flange, cylindrical shell
  - Flange conical shell 1
  - Flange conical shell 2
  - Flange- spherical shell 1
  - Flange- spherical shell 2

- **Flange face 1:**
  - type A (flat face)
  - type B (raised face)
  - type C (tongue)
  - type D (groove)
  - type E (spigot)
  - type F (recess)
  - type G (O-ring spigot)
  - type H (O- ring groove)
  - type I (RTJ-groove)
  - type J (chamfer)

- **flange type 2:**
  Same like flange type 1
  additionally:
  symmetrical flange
  blank flange 1
  blank flange 2

- **Flange face 2:**
  Like flange 1: flange face 2

- **Type of bolts:**
  screw
  anti fatigue bolt
  stud bolt

- **Extension sleeve:**
  yes
  no

- **Type of gasket:**
  Flat gasket (Form FF)
  Type IBC- flat gasket
  Non-metallic flat gasket (Form TG)
  Non-metallic flat gasket (Form SR)
  Rubber gasket with inserts
  Sheet gasket with inner eyelet
  Spiral wound gasket
  Sheet gasket with PTFE- envelop
  Metallic gasket with flat or corrugated profile (type SC)
  Metallic gasket with flat or corrugated profile (type CR)
  RTJ- gasket (oval type)
  RTJ- gasket (octogonal type)
  Kammprofile gasket
  Metal jacketed gasket with layers

In the header of the user interface (area 2) the tabs representing various input masks are displayed. Tabs that are not required according to the preselections made in area 1 are not displayed. If you miss a tab, please check preselections.

In the central region (region 3) of the user interface are the specific Input fields. These tabs include drawings which illustrating the required data.

In all input masks there is the possibility to save the input data by clicking the button "save record“ and selecting a drive, a folder and a file name. The stored data can be read via the button “open data“ after selecting a drive, a folder and a file name.

Some of these input tabs are always available, while others are only displayed if the corresponding preset value is selected. The tabs, which are always present, include:

- **general:** In this tab can be entered general information for the flange calculation;
- **load:** In this tab the temperature and pressure loads can be defined which will be included in the calculation. Similarly, external loads can be defined;
- **flange 1:** Depending on the type of flange appear different tabs to define the flange geometry;
- **raised faces:** Here the geometric dimension of the raised faces of the flanges cam be entered;
- **bolts:** Depending on the type of bolt different screens for defining the geometry of the bolt will appear;
- **thread:** Tab for entering the thread dimensions;
- **gasket geometry:** Entering the gasket dimensions;
- **material of gasket:** Tab for entering the required gasket characteristics;
- **fl. 1 material:** Entering the strength characteristics of the material for flange 1;
- **material of bolts:** Entering the strength characteristics of the material for the bolts;
- **assembly:** Defining the assembly parameters.

Furthermore, additional tabs can be displayed, which shall also be completed:

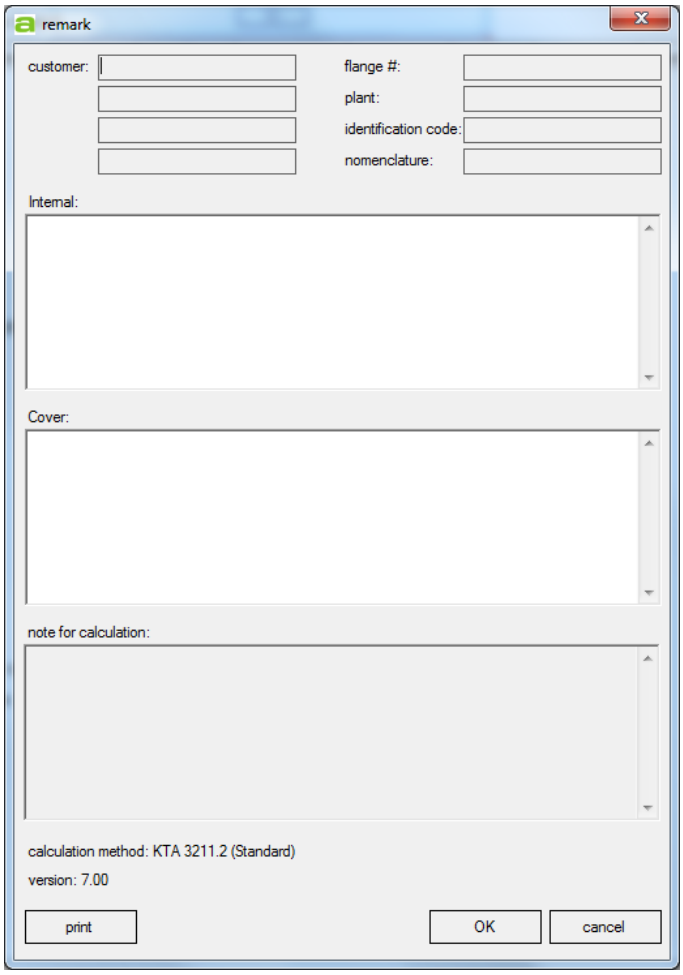
- **flange 2:** If the geometries of the two flanges differ, these can be entered separately.

- **fl. 2 material:** If the materials of the two flanges differ, these can be entered separately.
- **loose flange 1 material:** is for flange 1 the type “loose flange” selected and the material of the loose flange differs from stub/flare, these can be entered separately.
- **loose flange 2 material:** is for flange 2 the type “loose flange” selected and the material of the loose flange differs from stub/flare, these can be entered separately.
- **shell 1 material:** Entering the strength characteristics of the material for shell 1 (only EN 1591).
- **shell 2 material:** Entering the strength characteristics of the material for shell 2 (only EN 1591).
- **extension sleeve geometry:** In these selection must be entered the geometry of the expansion sleeves.
- **extension sleeve material:** In these selection must be entered the material of the expansion sleeves.

In the lower left region of the window (area 4) several buttons are arranged to give access to the following functions:

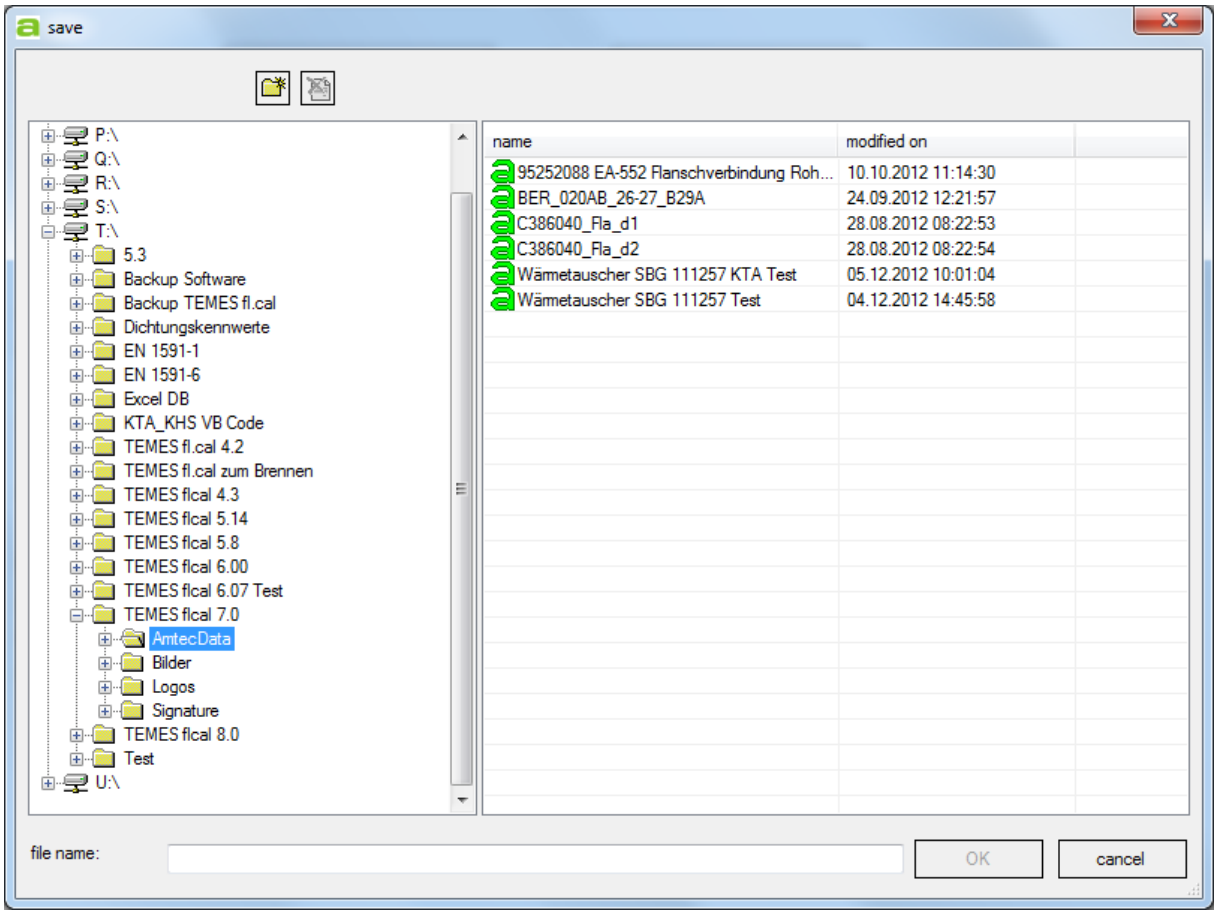
- **version:** contains information about the installed versions of each **TEMES*fl.cal*** - component ,

- **new:** a new, empty file is created,
- **remark:** a remark window opens to document important information about the present calculation,

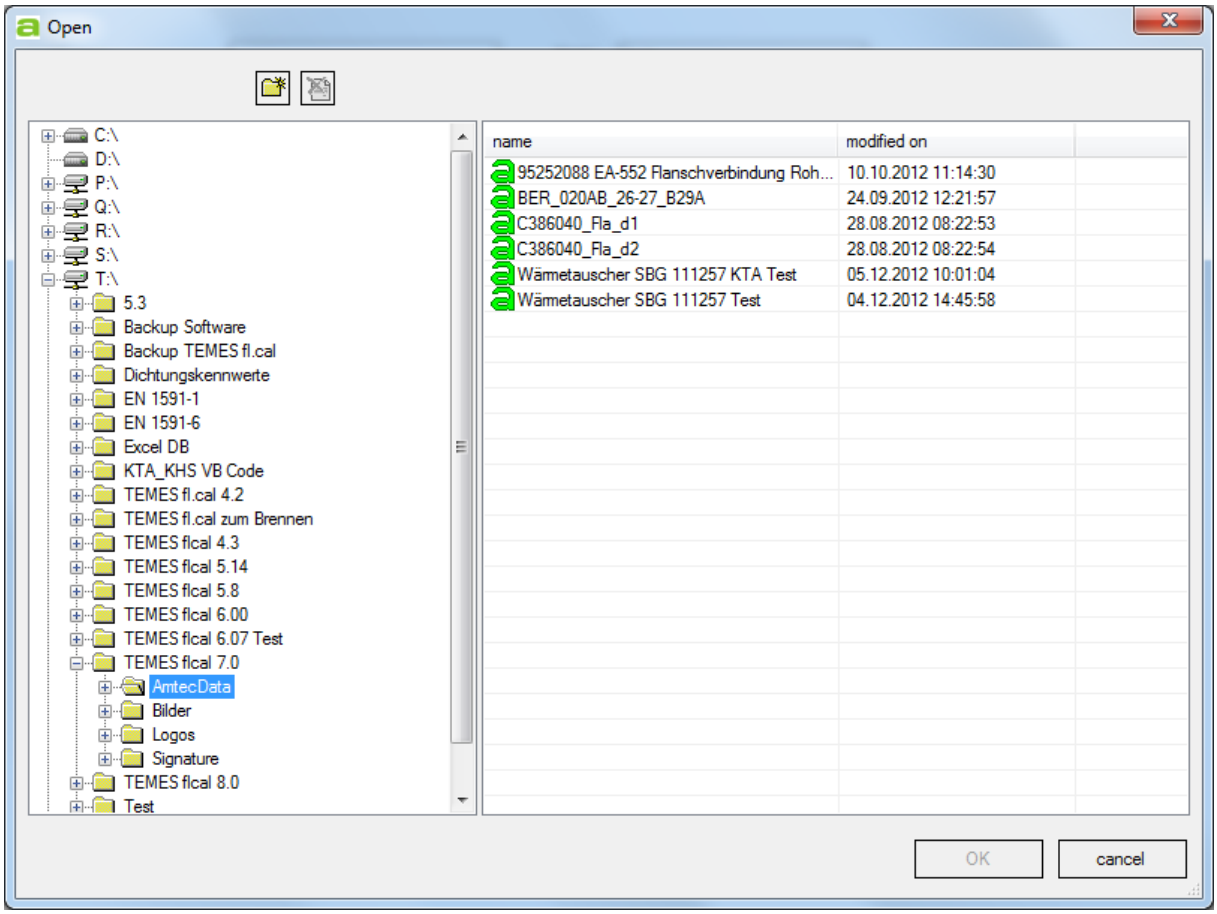


- **calculation:** the calculation can be started as soon as you have entered all information,

- **save:** save file before a calculation starts,



- **open:** open an existing file,



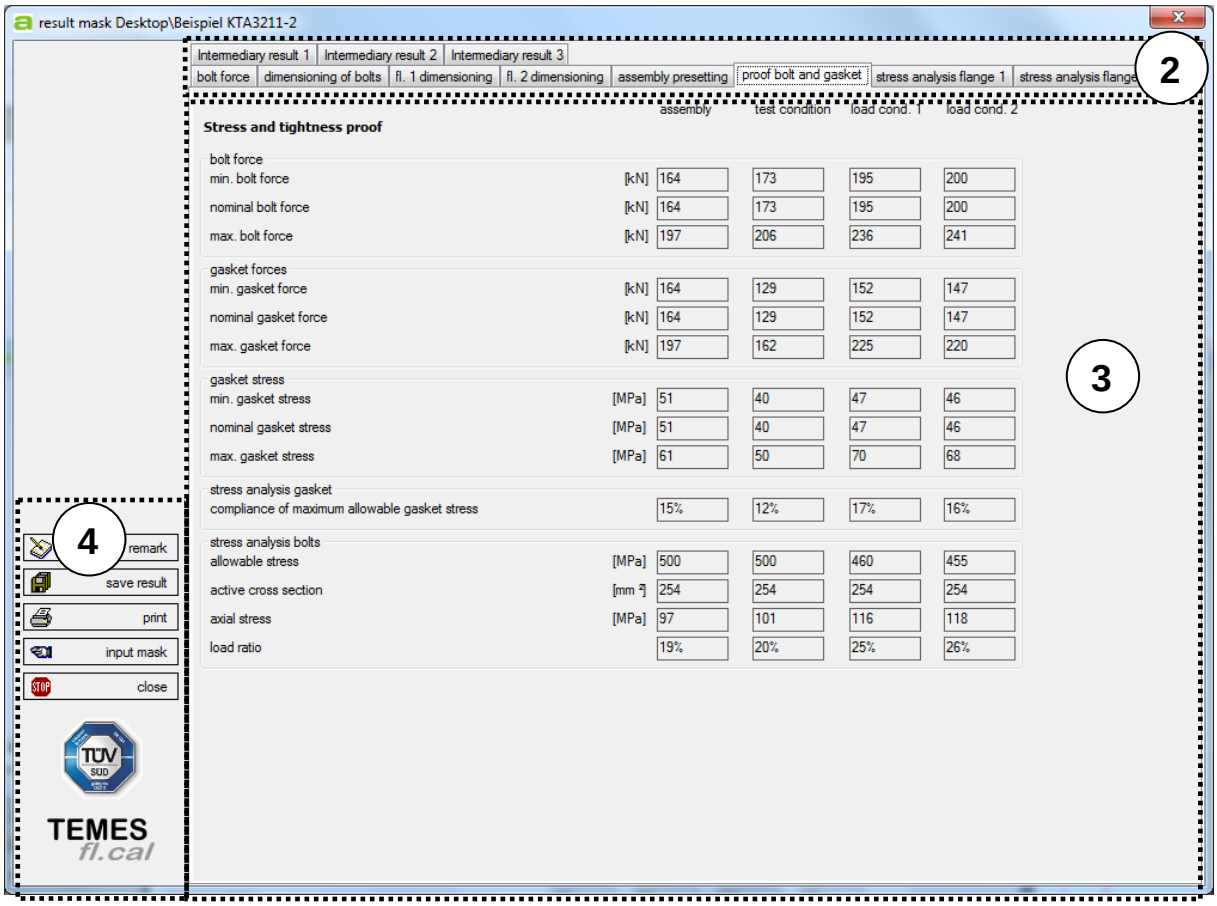
- **close:** closes the program.

The following section 3.3 describes the main page of the **TEMES*fl.cal*** - presentation of results.

3.3 TEMES*fl.cal* results – general information

With the “calculation“ button in the lower left area of the user interface window you can start the calculation. If all input data is available, the calculation is performed and the program in EN 1591 calculation module jumps to the output tab "assembly presetting".

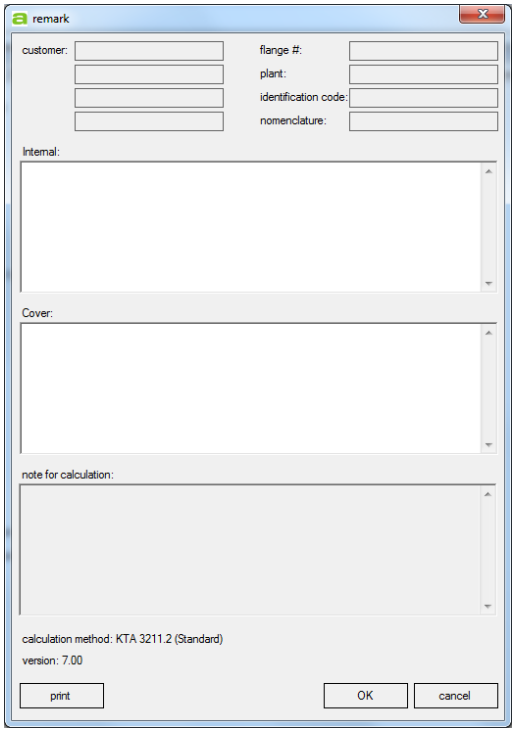
The structure of the results masks is similar to the structure of the input masks (as an example, see below the output mask "proof bolt and gasket" of KTA 3211.2 (KHS) calculation module).


result mask Desktop\Beispiel KTA3211-2
Intermediary result 1
Intermediary result 2
Intermediary result 3
bolt force
dimensioning of bolts
fl. 1 dimensioning
fl. 2 dimensioning
assembly presetting
proof bolt and gasket
stress analysis flange 1
stress analysis flange
2
assembly
test condition
load cond. 1
load cond. 2
Stress and tightness proof
bolt force
min. bolt force [kN] 164 173 195 200
nominal bolt force [kN] 164 173 195 200
max. bolt force [kN] 197 206 236 241
gasket forces
min. gasket force [kN] 164 129 152 147
nominal gasket force [kN] 164 129 152 147
max. gasket force [kN] 197 162 225 220
gasket stress
min. gasket stress [MPa] 51 40 47 46
nominal gasket stress [MPa] 51 40 47 46
max. gasket stress [MPa] 61 50 70 68
stress analysis gasket
compliance of maximum allowable gasket stress 15% 12% 17% 16%
stress analysis bolts
allowable stress [MPa] 500 500 460 455
active cross section [mm²] 254 254 254 254
axial stress [MPa] 97 101 116 118
load ratio 19% 20% 25% 26%
3
4
remark
save result
print
input mask
close
TEMES
fl.cal

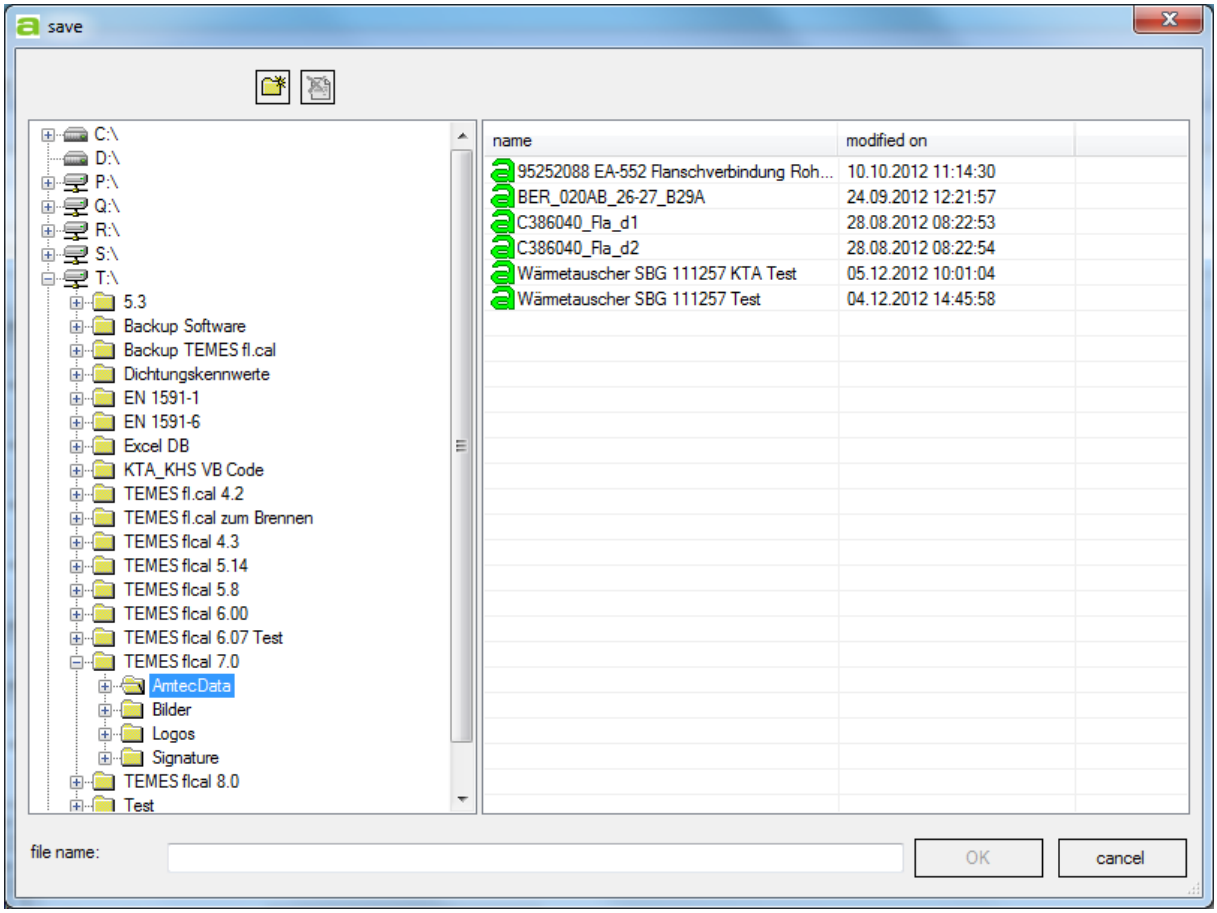
The header of the result mask (area 2) appears in dependence of the choices made for preset data (area 1 of the input window). For each tab a different set of data will be displayed in the results section (area 3). A detailed description of the different result tabs is given in the results sections below.

On the left side (area 4), the arranged buttons have the following functions:

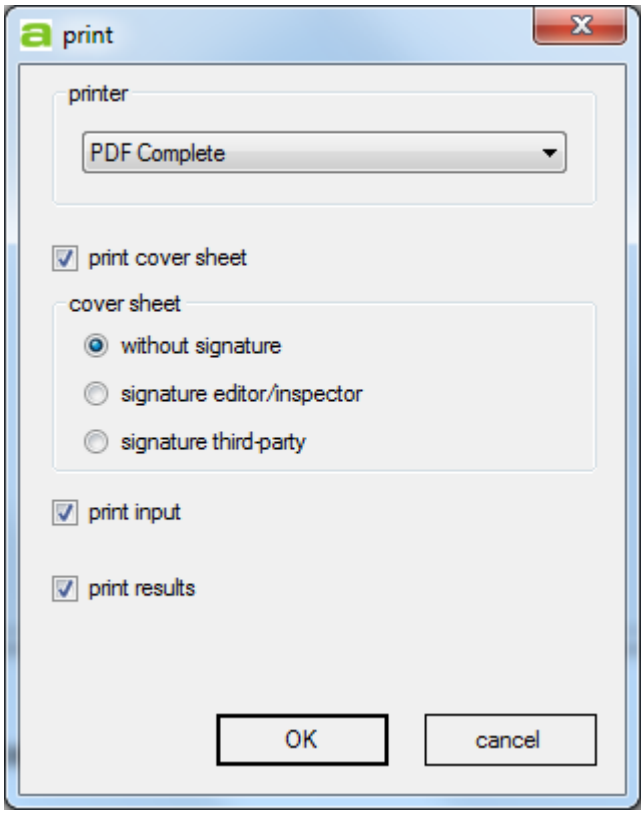
- **remark:** enter additional information about the current calculation (it is also possible to print this information),



- **save result:** Saves the entire file, including the input values, calculation results and the selected assembly requirements,



- **print:** With this button, the calculation data is sent to the configured default printer or another printer installed. The scope (input, result) can be selected. If a PDF writer is installed on the PC, the calculation can be saved as a pdf-file.



- **input mask:** back to the input mask to modify input values or to change the calculation method,

- **close:** button to close the software **TEMES*fl.cal*** or to change the calculation method.

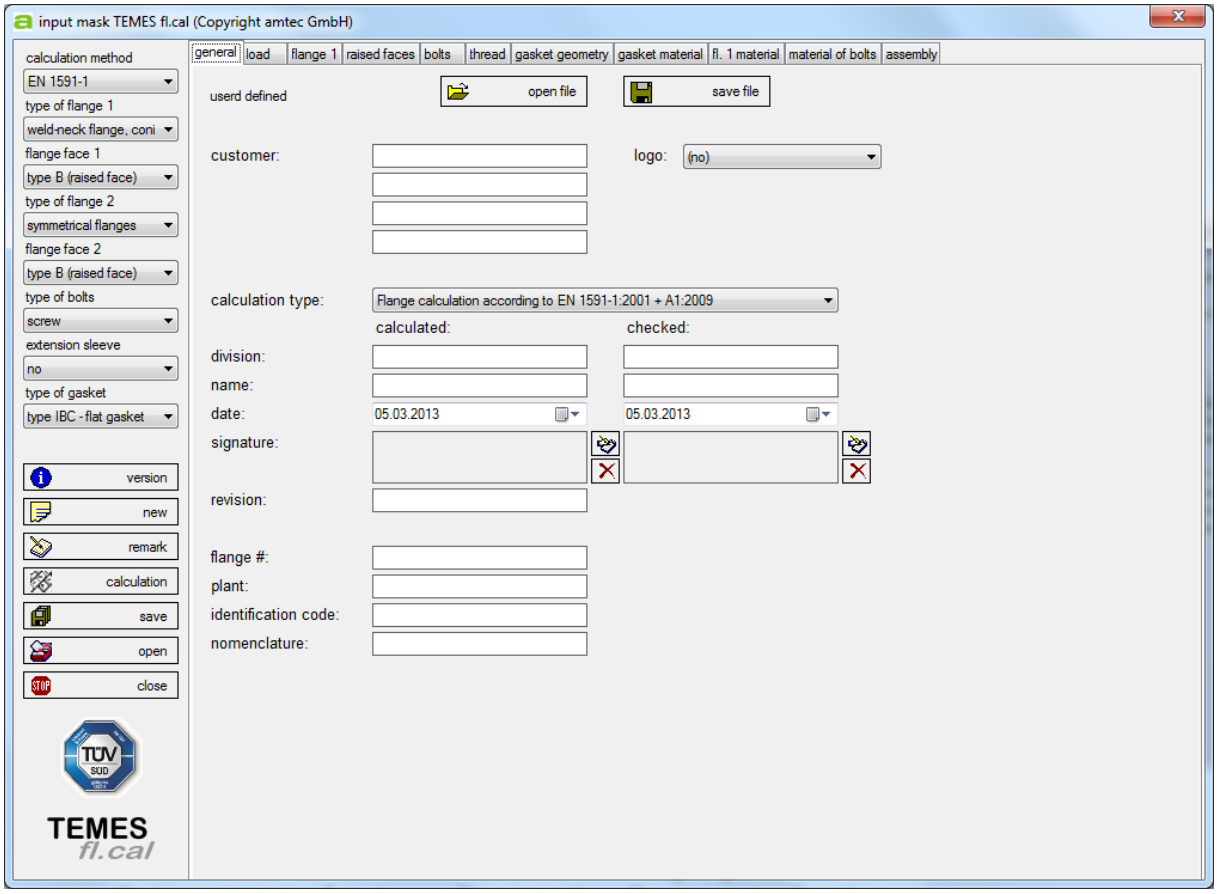
In the following chapters the different input masks will be described in detail in the context of the chosen calculation method.

3.4 Program module EN 1591 – user interface

This chapter describes the input screens of the program module EN 1591:

3.4.1 Mask “general“

In the mask “general“, you can enter information about the calculation, see screenshot below.



There are four input fields for customer data, fields for division, name, date and signature of the editor in the column “calculated:” and the same four fields for the auditor in the column “checked:” as well as the revision of the calculation. For a unique assignment of the calculation to a flanged joint, a flange number, plant name, identification code and a nomenclature (description) of the flange can be entered.

The logo of the customer you are making the calculation for must be in *.wmf-format added in the installation folder of your **TEMES**$_{fl.cal}$ installation (e.g. D:\TEMES flcal 7.xx\logo.wmf).
For optimal viewing and logo quality, we recommend an aspect ratio of 1:3.
This logo is then automatically added to the calculation printout.

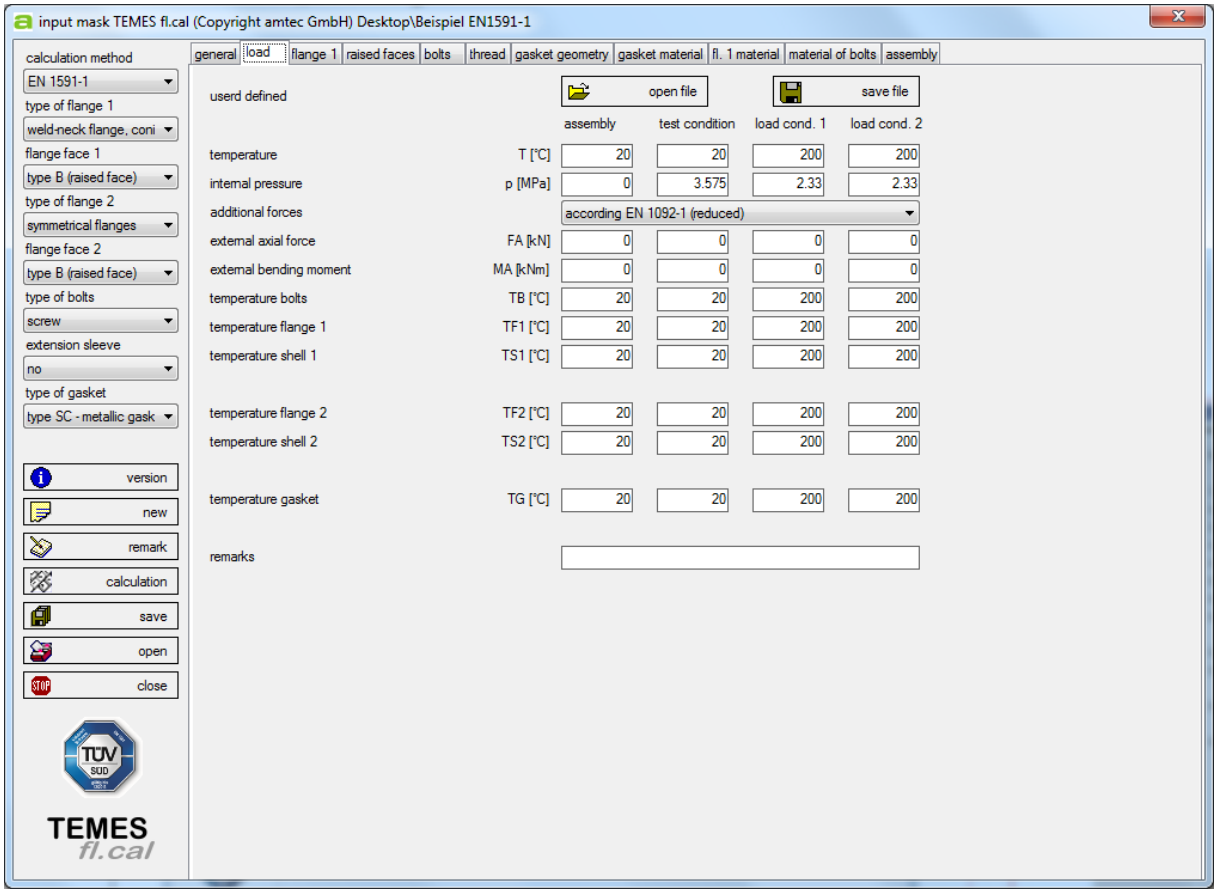
These inputs can be stored with the button "save file" and are available for further calculations.
With the button "open file" you can fill in all input fields on this mask with predefined values.

3.4.2 Mask “load“

In the mask "load" four load cases are specified:

- assembly (assembly conditions, unpressurized, bolting torque)
- test condition (leak test)
- Operation 1 (e.g. normal operation)
- Operation 2 (e.g. operation with design conditions)

For each of the four load cases the loads temperature, internal pressure, external axial force and bending moment can be defined. The consideration of shear forces and torsional moments is not possible in EN 1591-1.



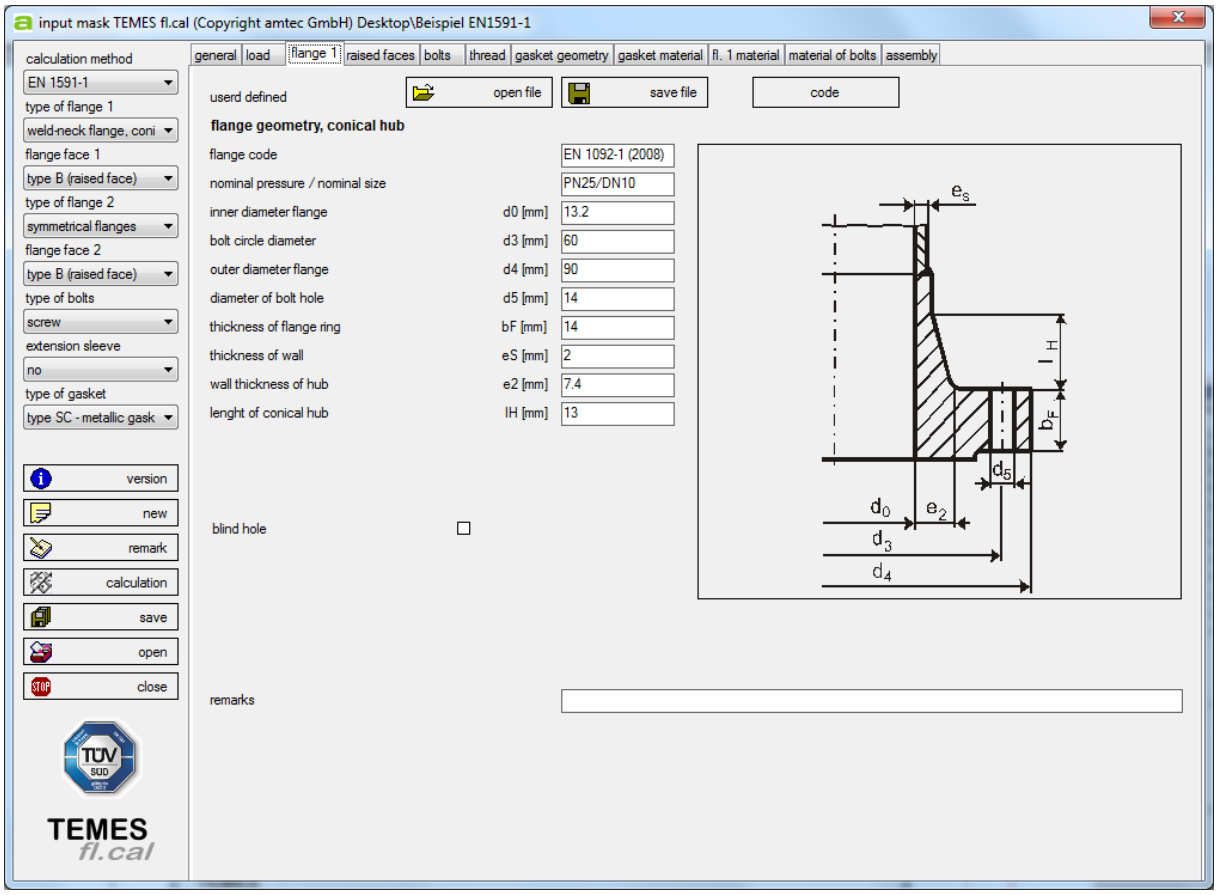
In accordance with the entries in the "temperature" input field, the temperature of each load case is applied to all components of the connection. It is also possible to assign individual component temperatures in the input fields below but if you enter a value in the “temperature” input field at the top of the mask, all individual component temperatures for this load case are replaced with the global value.

Also affected by changes in temperature input are the strength values of the flanges and bolts, unless they are read from the database.

These inputs can be stored with the Button "save file" and are available for further calculations.
The reading of data is done via the button "open file" in this mask.

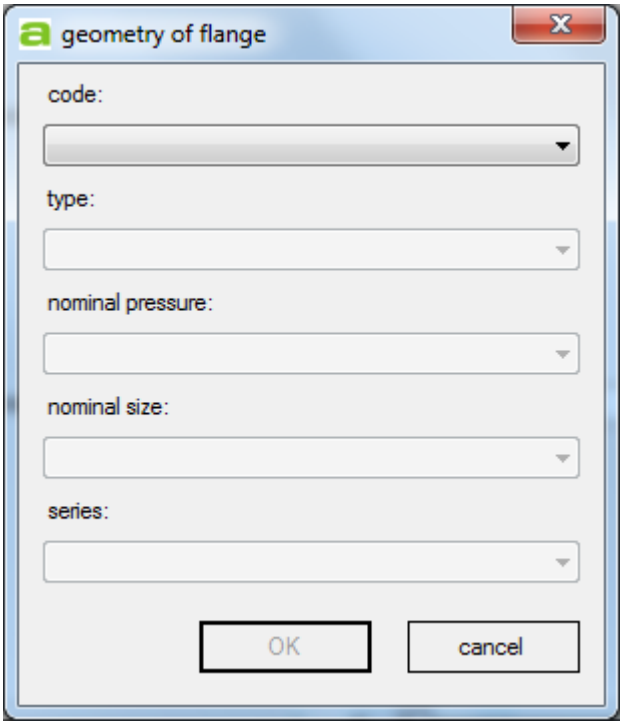
3.4.3 Mask “flange 1“

Depending on the selected flange geometry different input masks are available.



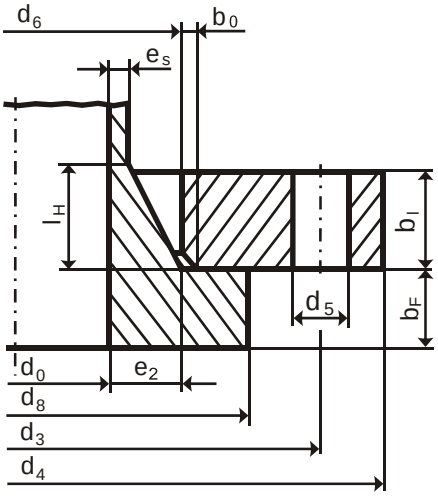
To illustrate the required input variables, a drawing of the part is displayed in the right area, showing the nomenclature of the geometry dimensions.

The numerical values can either be entered manually in the fields, or – if the dimensions are defined in a standard – they can be read from a database. For this purpose you find the button "code".

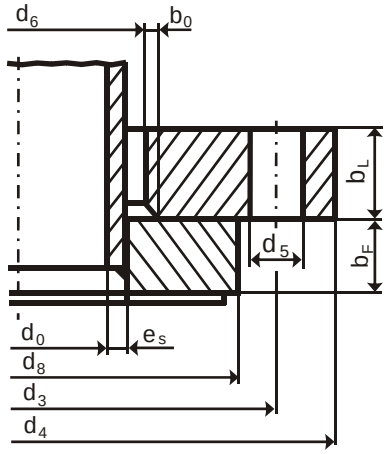


The following different geometrical shapes can be defined for flange 1:

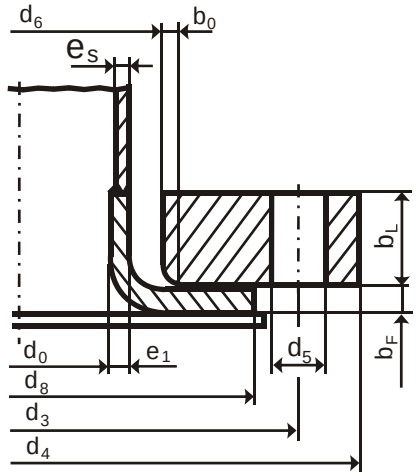
- loose flange, conical hub



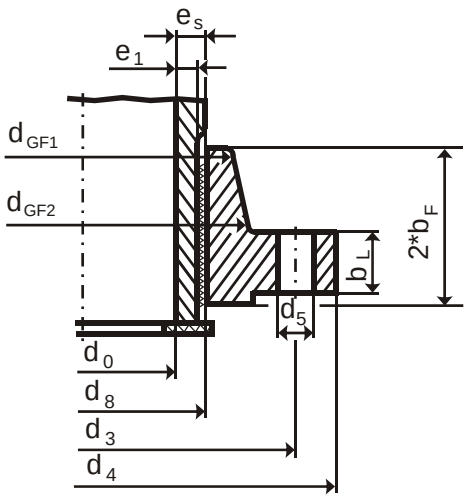
- Loose flange, cylindrical hub 1



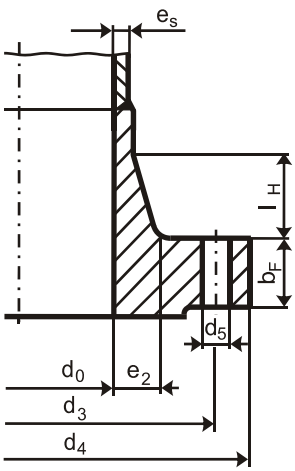
- Loose flange, cylindrical hub 2



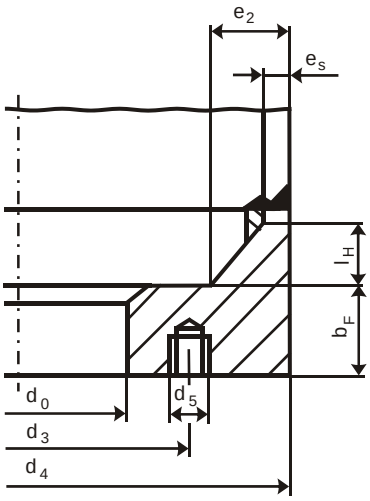
- hubbed threaded flange



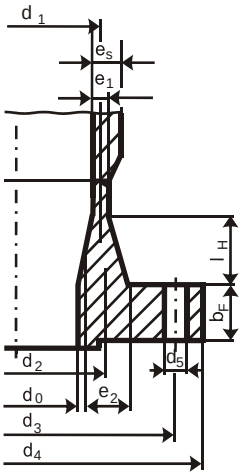
- weld-neck flange, conical shell 1



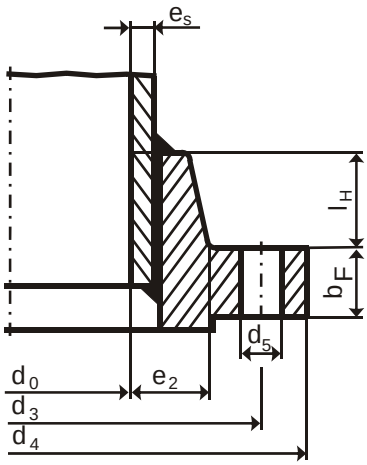
- weld-neck flange, conical shell 2



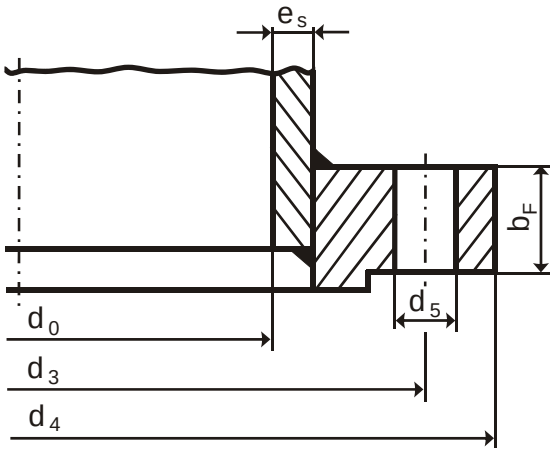
- weld-neck flange, conical shell 3



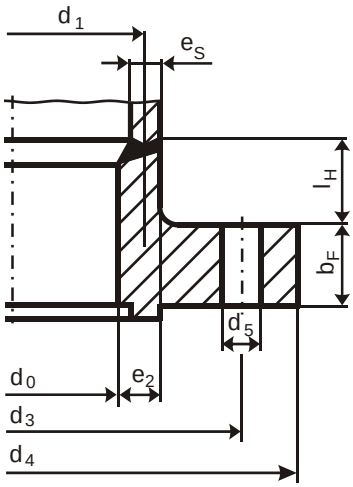
- hubbed slip-on welded flange



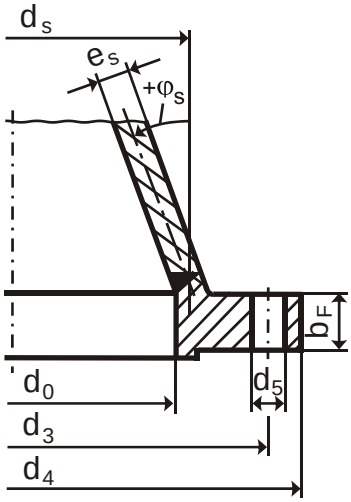
- weld-on plate flange



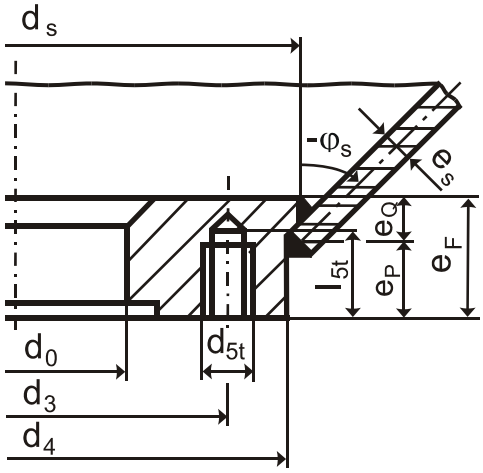
- weld-neck flange, cylindrical shell



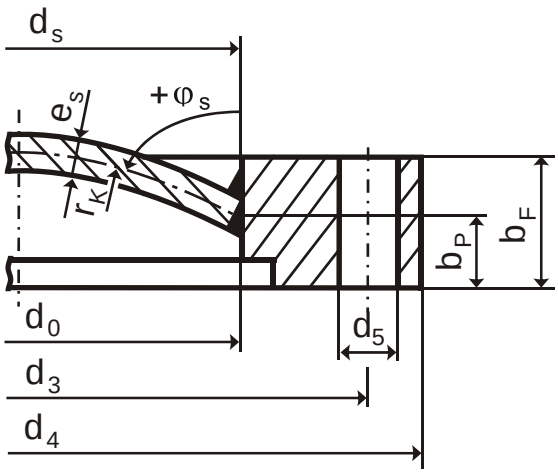
- flange, conical shells 1



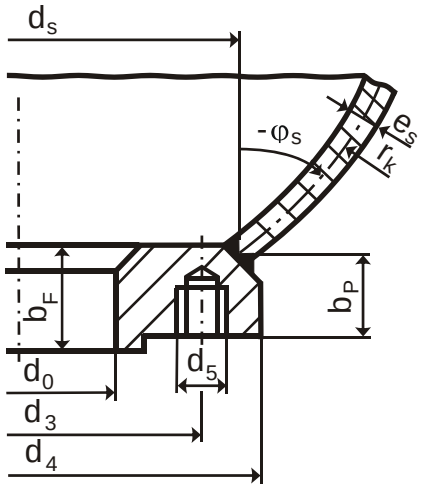
- flange, conical shells 2



- flange spherical shell 1



- flange spherical shell 2



A blind flange can be modeled only as a flange 2.

For welding flanges and flanges on conical and spherical shells, a blind hole can be modeled in the "flange 1". For this purpose, must be labeled "blind hole." Then there appear additional input fields.

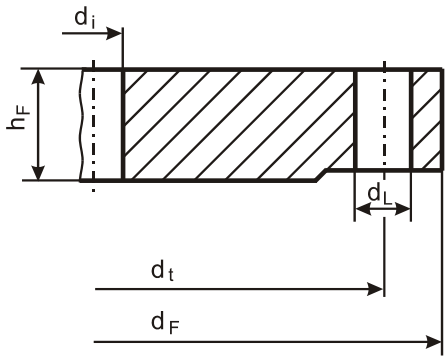
These inputs can stored with the Button "Save File" and are available for further calculations.
The reading of data is done via the button "Open file" in this mask.

3.4.4 Mask “geometry Flange 2”

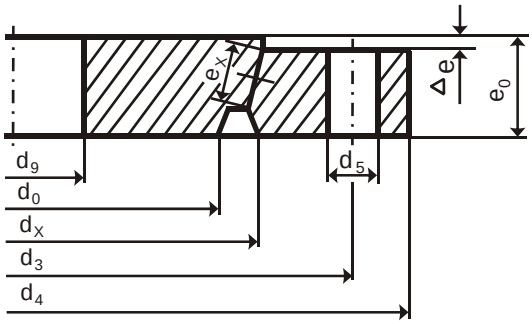
Essentially the input masks for flange 1 and 2 are identical; the input options are the same. The following differences should be noted:

- In the pre-selection "Symmetrical Flange" you don’t need to enter the geometric data for flange 2,
- A blind hole can just be modeled in flange 1,
- Flanges on conical and spherical shells can also be modeled only as a flange first,
- A blind flange must be modelled as a flange 2.

o blind flange 1



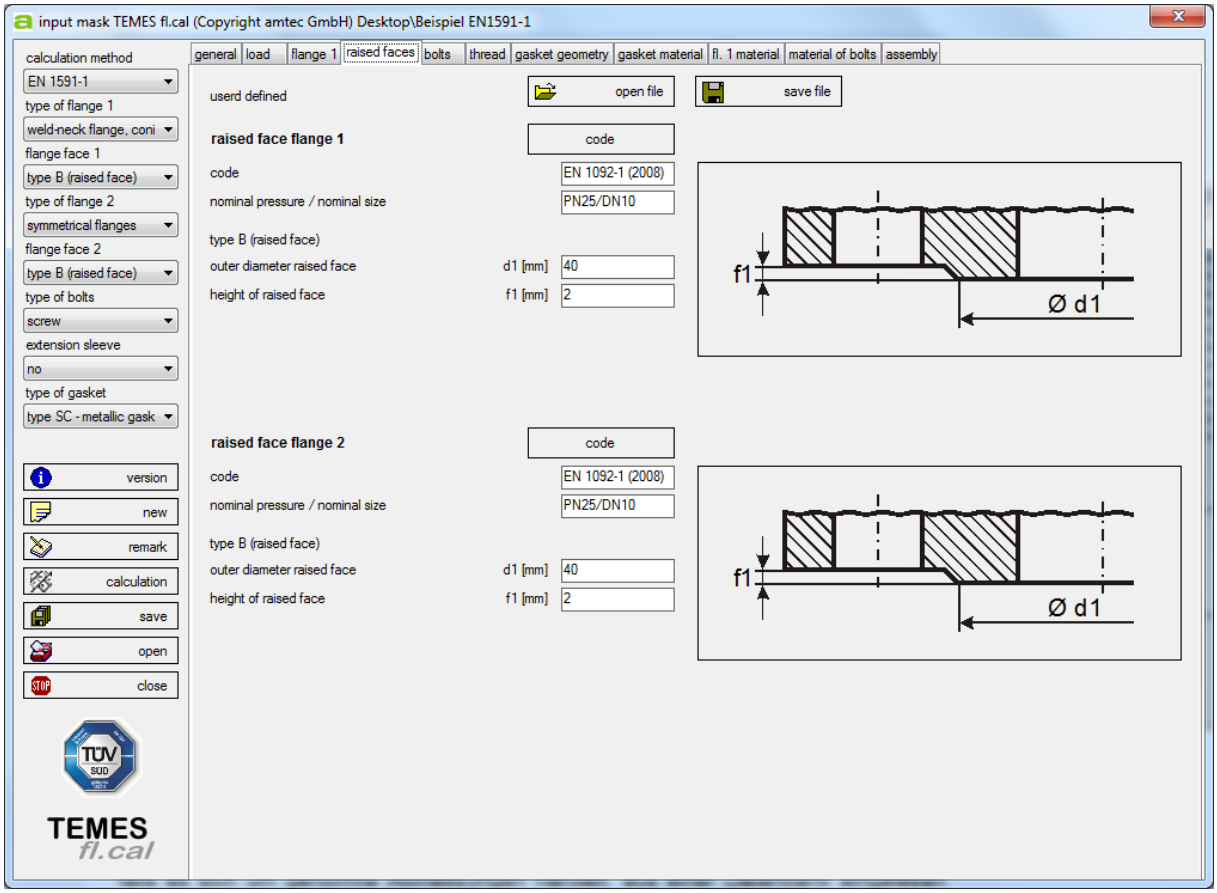
o blind flange 2



3.4.5 Mask “raised faces“

To accurately calculate the clamping length of the bolts and the effective pressed gasket geometry you can define the geometry of the „raised faces“ for both flanges in the mask „raised faces“ (if earlier the selection made in the dialog boxes).

To illustrate the required input variables, a drawing of the selected raised faices is shown with the required geometric quantities in the right area.



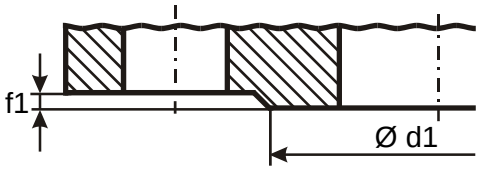
The numerical values can either be entered manually in the fields or, if it is standardized dimensions are read from a database. For this purpose is the button "norm" available.

The following raised faces geometries are available:

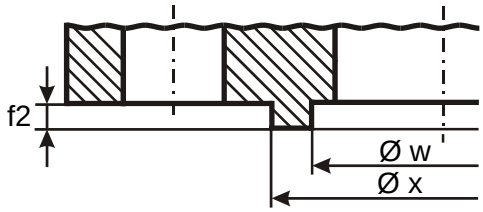
- type A (flat face)

-

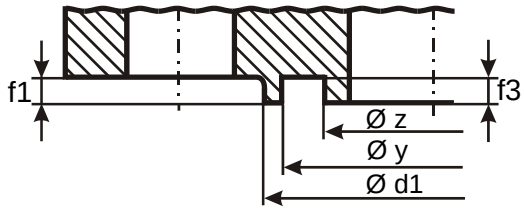
- type B (raised face)



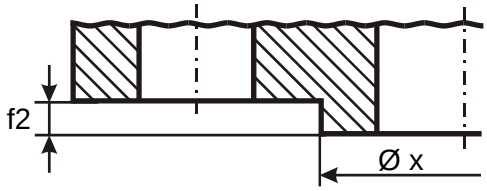
- type C (tongue)



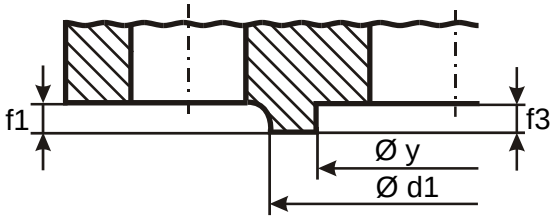
- type D (groove)



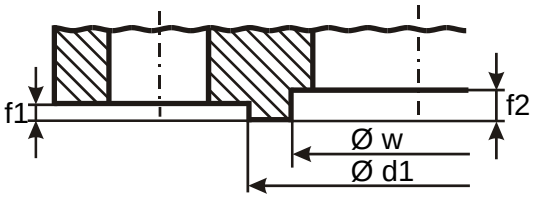
- type E (spigot)



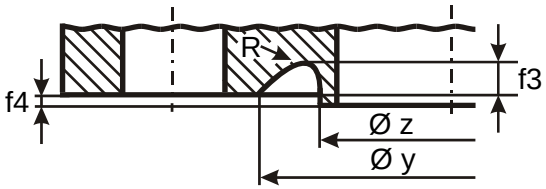
- type F (recess)



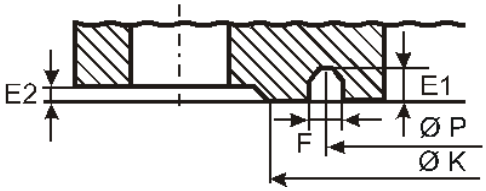
- type G (O-Ring spigot)



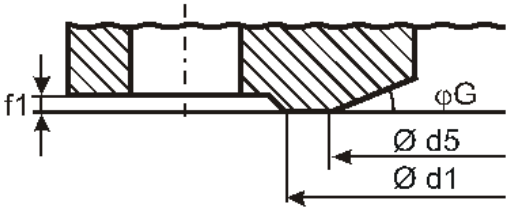
- type H (O-Ring groove)



- type I (RTJ- groove)



- type J (chamfer)



After you select "Symmetrical Flange" in the dialog box "flange 2" and choosed a raised face for this flange, the opposite side automatically select the raised face that fits to flange 1. If this is not desired, an individual input must be done for "flange 2"

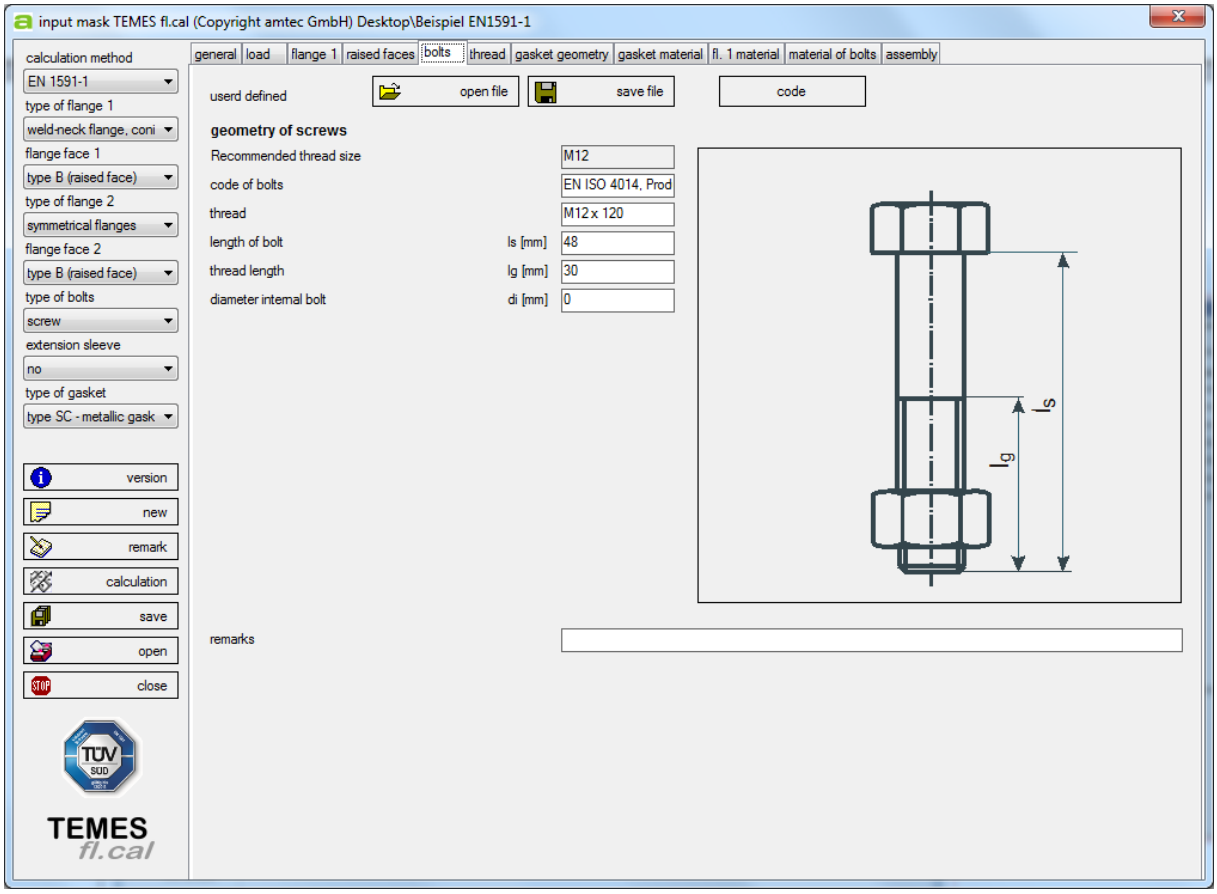
Also, the sealing surfaces can stored with the button "save record and are available for further calculations again. The reading of this data is done via the button "open data" on the same screen.

On a blind flange it is to ensure the correct entering of the raised face, because of the flange thickness of the central portion of the flange must be considered. An additional

input of a raised face (Form B) would mean in this case a too large length of the clamping lengths of the bolt. It is therefore advisable to select the raised face type A

3.4.6 Mask “bolts“

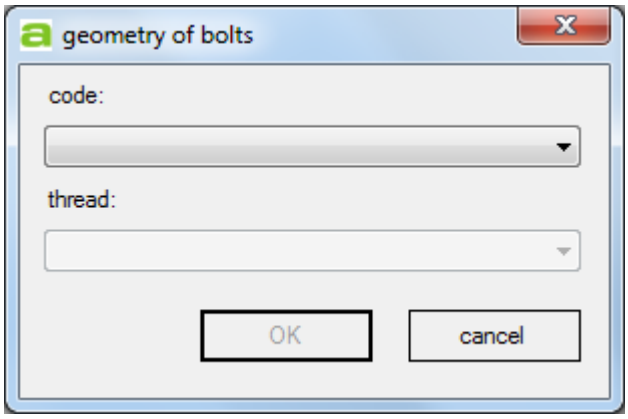
In dependence on the selected bolt various input forms are available.



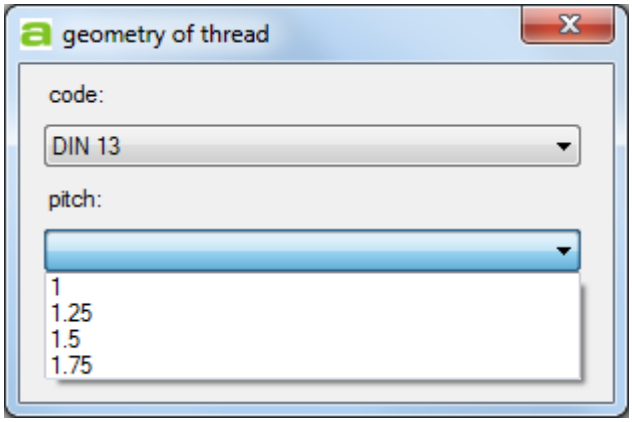
To illustrate the required input variables, a drawing of the part is shown in the right area, showing the nomenclature of the geometry sizes.

At the top line of the input mask, the recommended thread is displayed, which is defined by the flange geometry you previously defined.

The numerical values can either be entered manually in the fields or, if can be read from a database if the dimensions are standardized. For this purpose the button "code" is available.



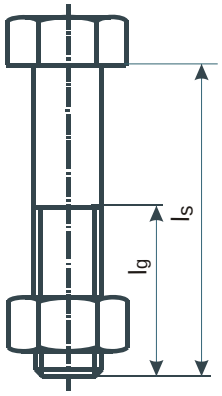
After determining the bolt standard (“code”), the program automatically moves to the input mask "thread geometry" to select the standard thread (and after the choice of the standard thread back to the screen "geometry of bolts").



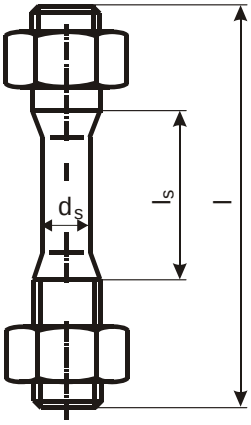
When the bolt geometry is entered manually, the thread geometry is defined directly in the input field "thread" of the mask.

The “type of bolts” with their corresponding nomenclature of geometry parameters can be selected on the left of the window from the following options:

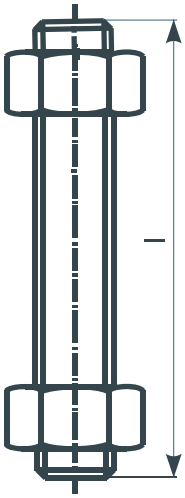
- screw



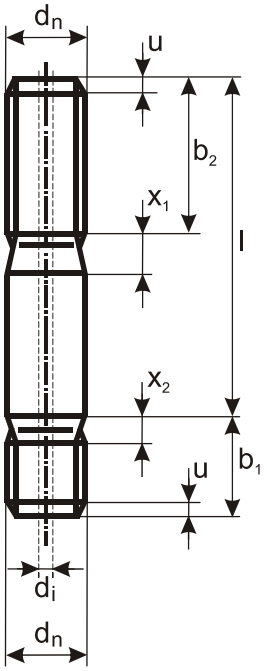
- anti-fatigue bolt



- stud



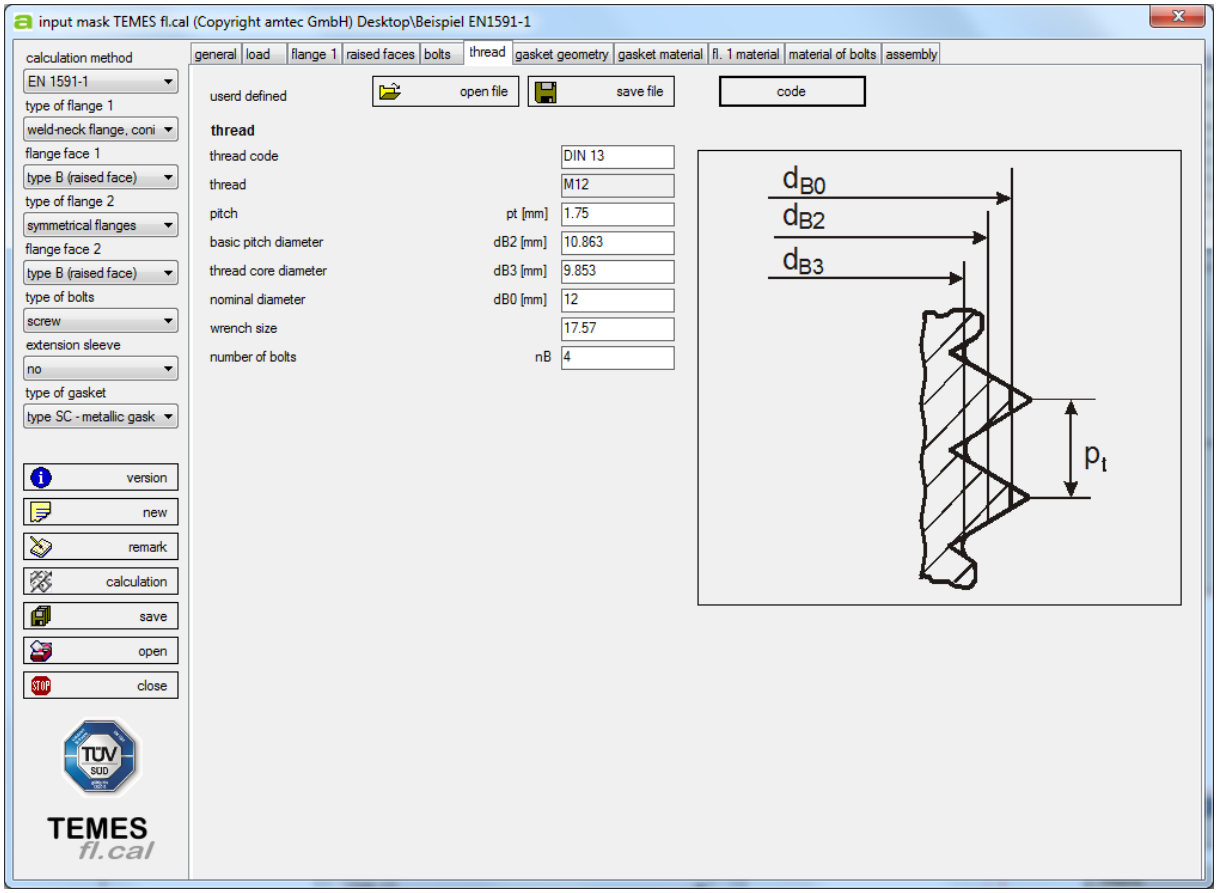
- stud metal end



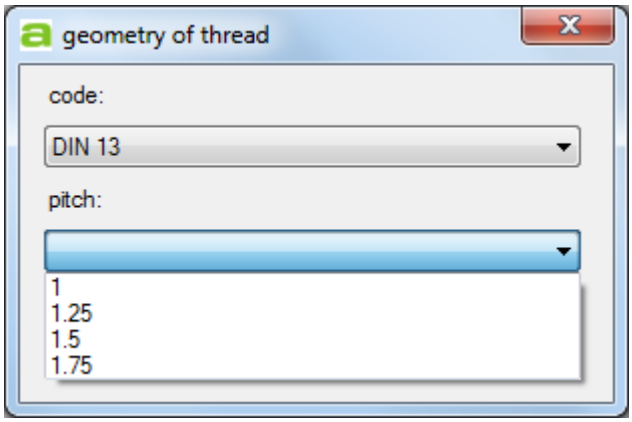
The input variables in the input mask "bolts" can be stored with the button „save file“ and are available for further calculations again. The reading of data is done via the button "open file" on the screen

3.4.7 Mask “thread“

For the geometry data of the thread a separate input mask is available. This mask may be filled automatically if a standard geometry for bolt and thread is selected in the "bolts” mask. In this case only the number of bolts has to be defined in the “thread” mask.



Here you have the option of manually entering the thread geometry or selecting a standard geometry.



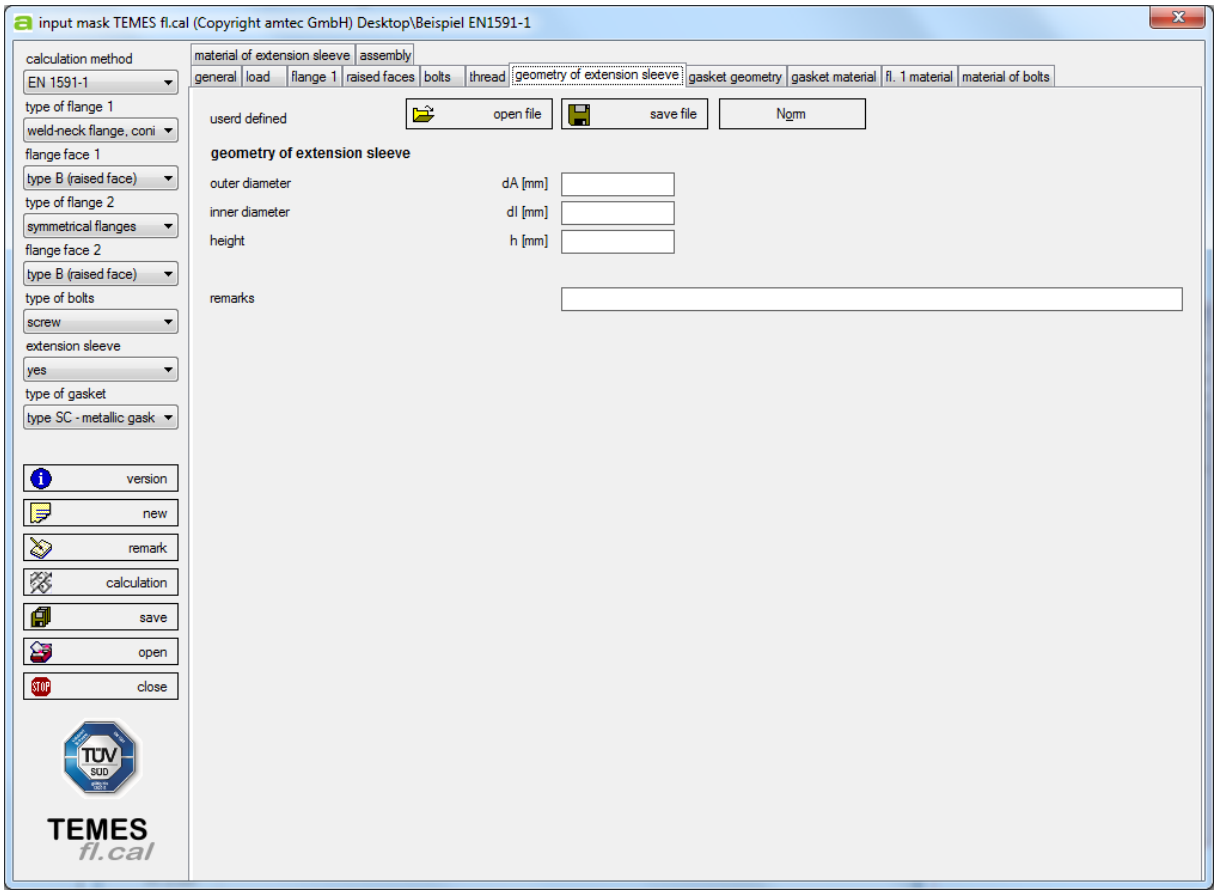
In this “thread” mask, the number of bolts of the flange connection is defined.

These inputs can be stored with the button "save file" in order to be available for further calculations.
The reading of data is done via the button "open file" in this mask.

3.4.8 Mask “geometry of extension sleeve“

If you have selected a flange with extension sleeves on the left side, a separate input mask appears. In this mask the outer diameter, the inner diameter and the height of the expansion sleeves need to be entered.

The expansion sleeves are used to calculate the correct clamping length of the bolts and spring as an additional element in the flange.



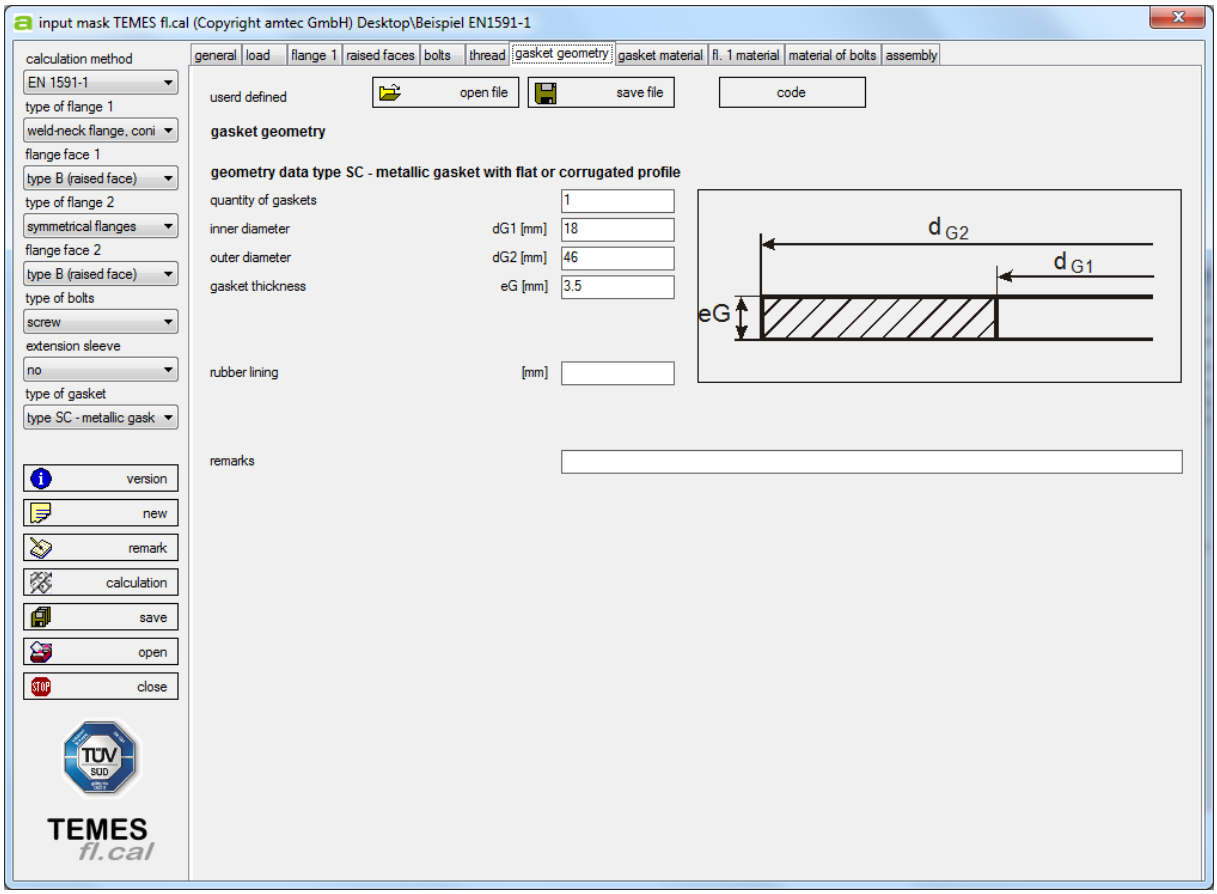
These inputs can be stored with the Button "save file" and are available for further calculations.

The reading of data is done via the button "open file" in this mask.

3.4.9 Mask “gasket geometry“

Depending on the selected flange geometry different input masks are available:

To illustrate the required input variables, a drawing of the seal is shown in the right area, showing the nomenclature of the geometry dimensions:

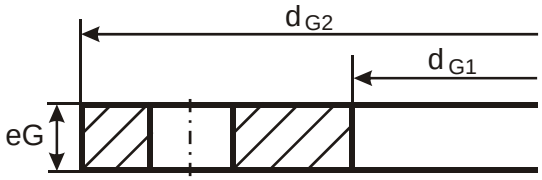


The different gasket parameters can either be entered manually in the fields or, read from a database if the dimensions are standardized. For this purpose the button "code" is available.

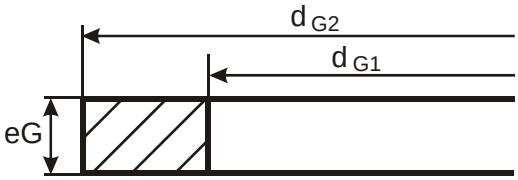
These inputs can be stored with the button "save file" and are available for further calculations.
The reading of data is done via the button "open file" in this mask.

The following different types of gaskets can be defined in order to achieve an accurate determination of the effective sealing surface and the acting lever arms:

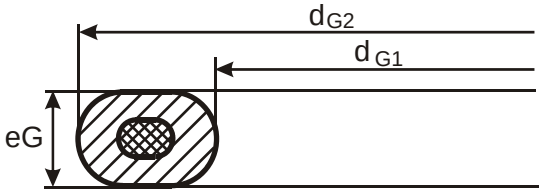
- flat gasket (type FF)



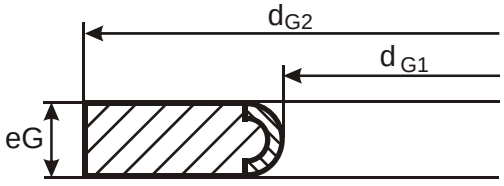
- non-metallic flat gasket (type IBC / TG / SR)



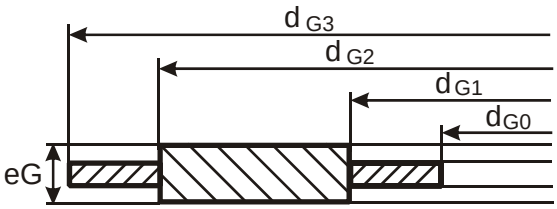
- rubber gasket with inserts



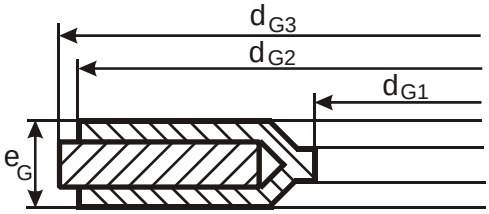
- sheet gasket with inner eyelet



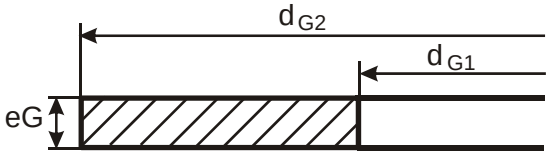
- spiral wound gasket



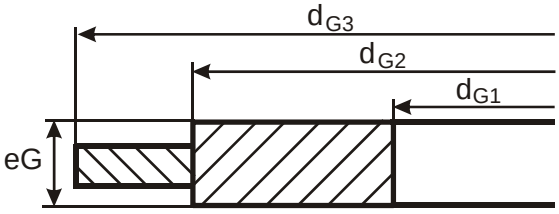
- sheet gasket with PTFE envelop



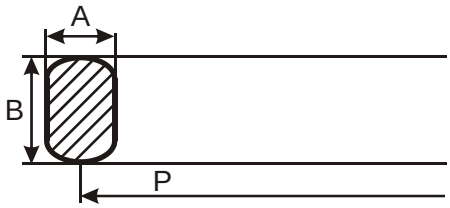
- metallic gasket with flat or corrugated profile (type SC)



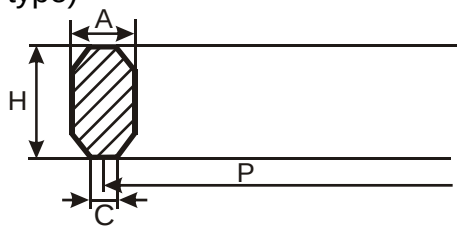
- metallic gasket with flat or corrugated profile (type CR)



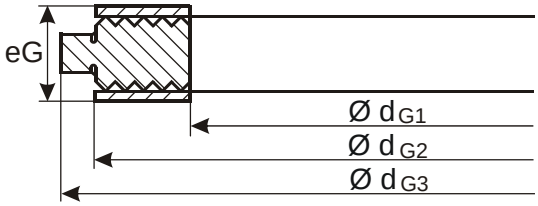
- RTJ-gasket (ovale type)



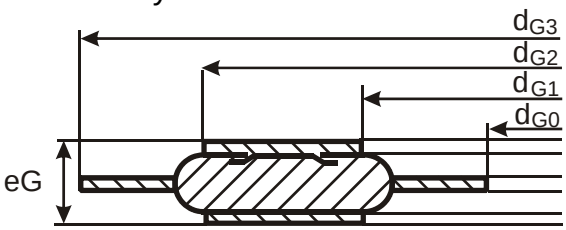
- RTJ-gasket (octagonal type)



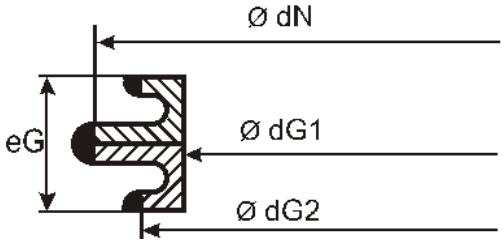
- kammprofile gasket



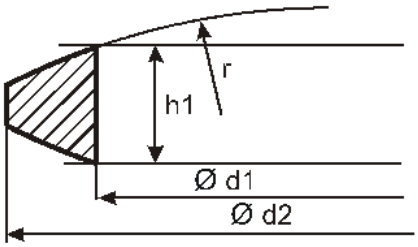
- metal jacketed gasket with layers



- welded lip gasket

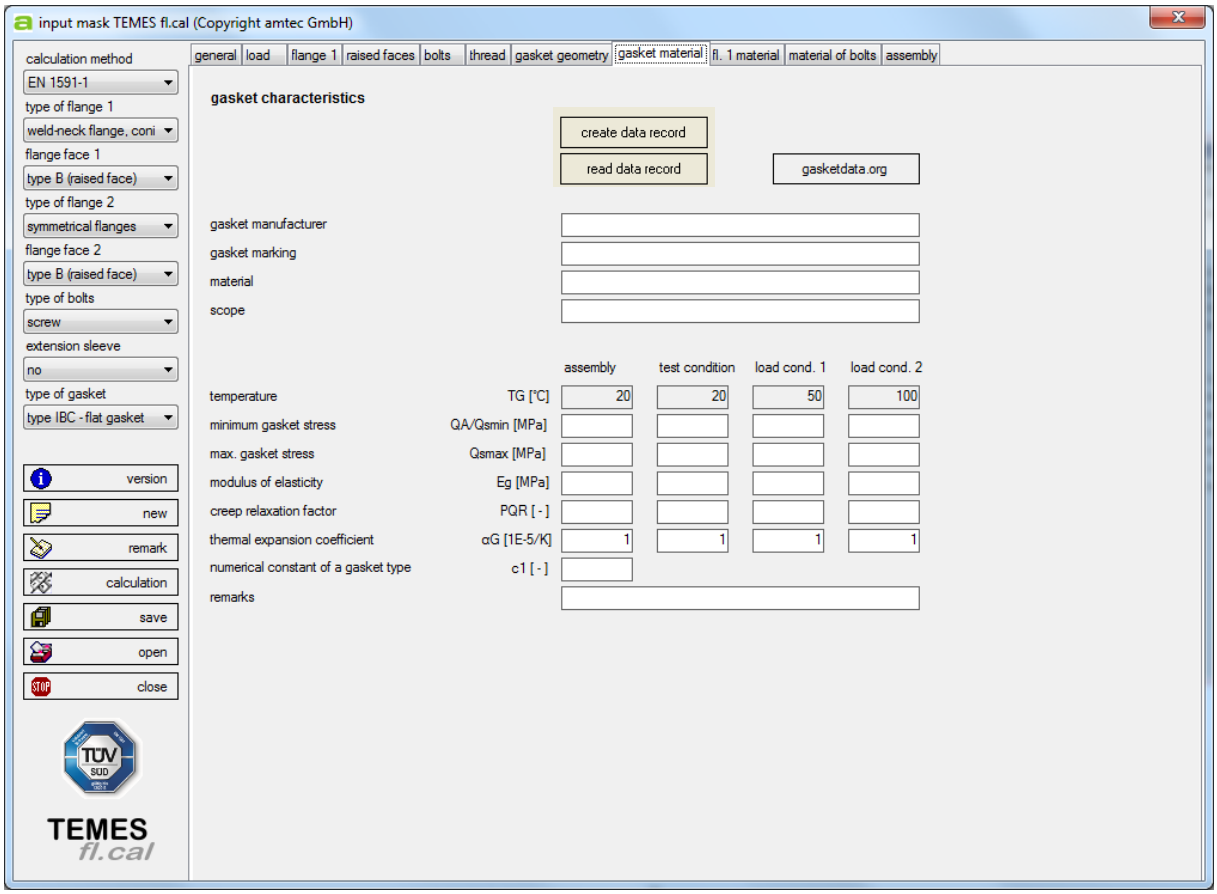


- lense gasket



3.4.10 Mask “gasket material“

In the input mask "gasket material" the gasket characteristics are entered according to DIN 28090-1.



Standard data are not available for the gasket characteristics or no longer reflect the state of the art.

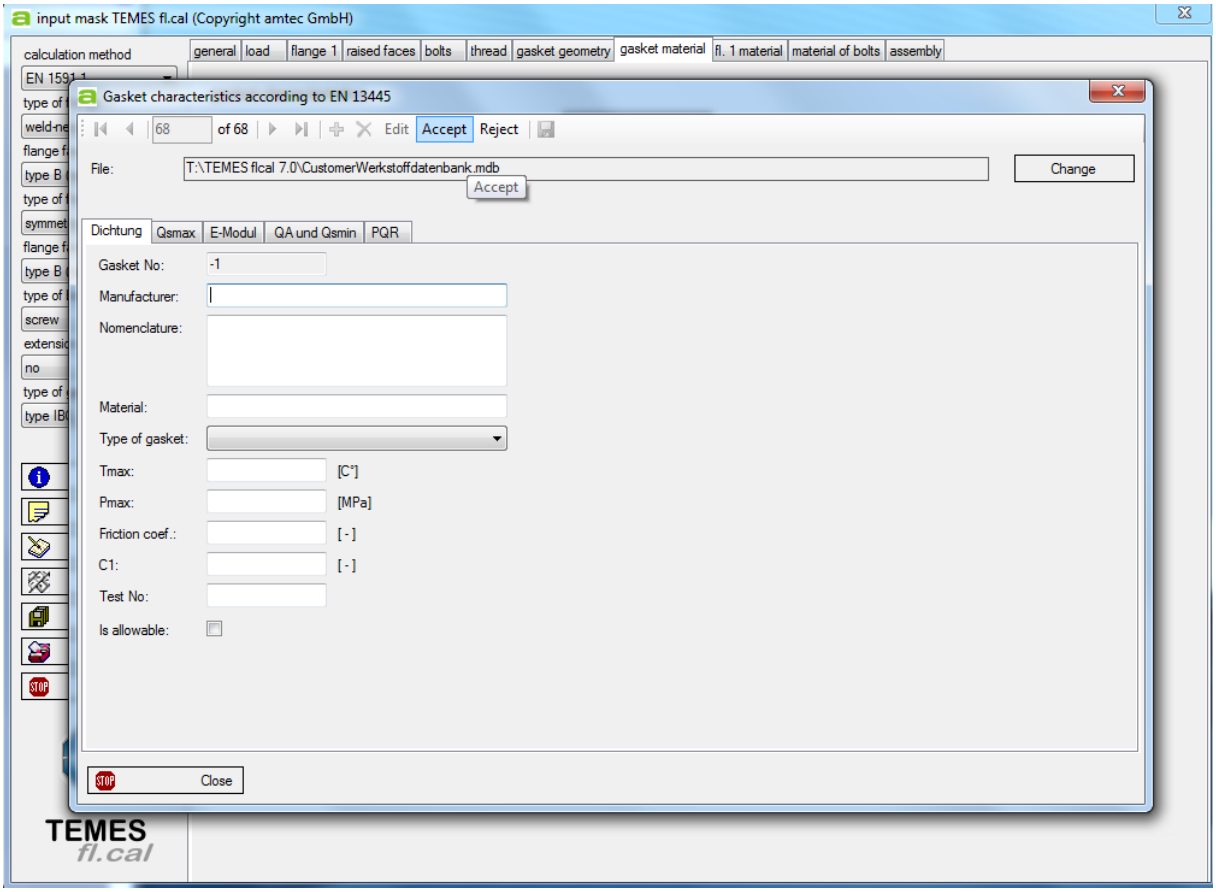
Gasket characteristics given from the manufacturers can be stored with the button "create data record" and are available for further calculations.
The reading of data is done via the button "read data record" in this mask.

Basically in EN 1591-1 only gasket characteristics determined according to EN 13555 should be used. For this purpose, the gasket manufacturer should be contacted.

With the button “create data record“ you can add gasket characteristics manually to the database.

Therefore you must open the “CustomerWerkstoffdatenbank” (materials database) in mask “gasket material“ with the “create data record“ button. You will find the database in the folder of your TEMES*fl.cal* installation.

X:\TEMESflcal7.xx\CustomerWerkstoffdatenbank.mdb



After opening the material database, you can record new characteristics with the button „+“. Here you will be asked in the first mask to specify the type of gasket, the gasket manufacturer and the gasket material.

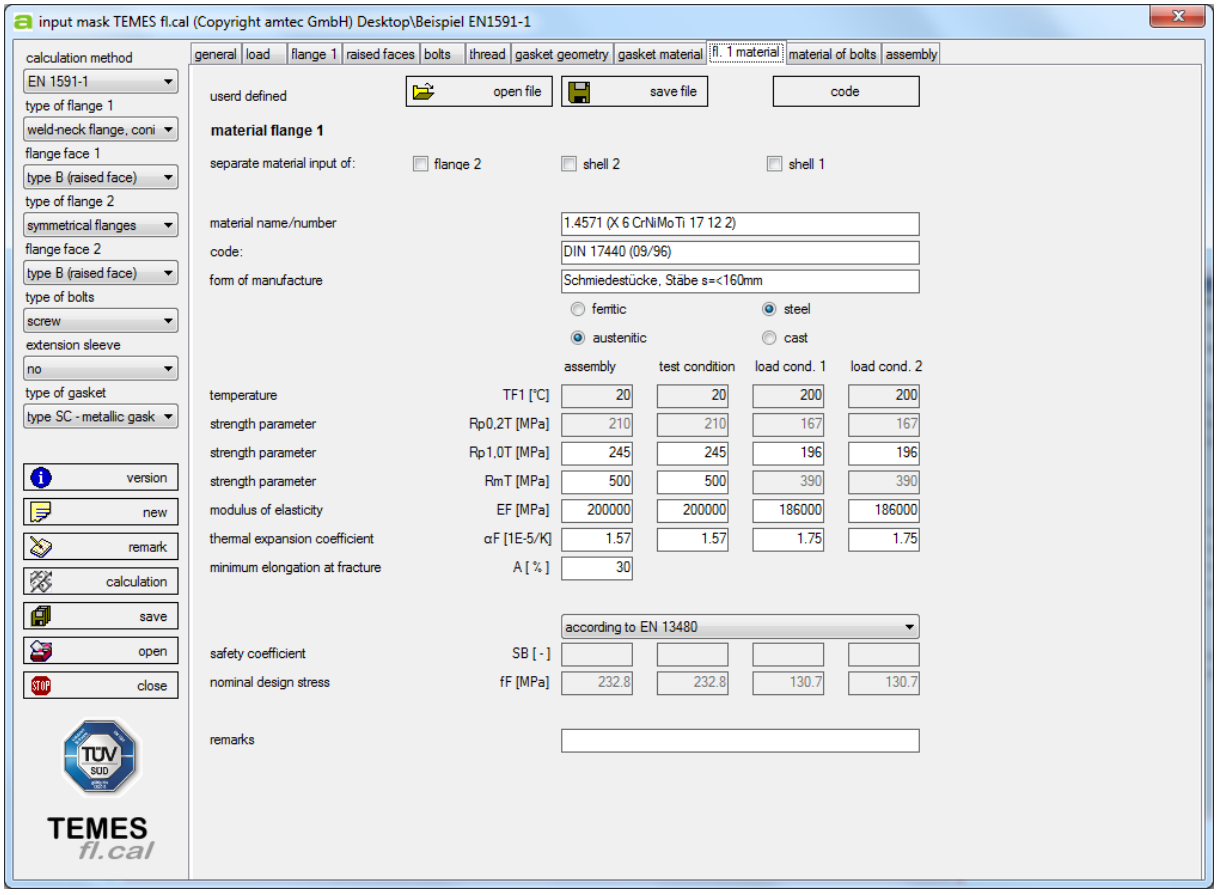
In the following input masks you can define gasket characteristics as the minimum and maximum required gasket stress, the thermal conductivity, the modulus of elasticity and the PQR value depending on the temperature and the design pressure.

After entering the parameters, click on the "Accept" button and the data is stored in the "CustomerWerkstoffdatenbank" (materials database) and is available for any further calculation.

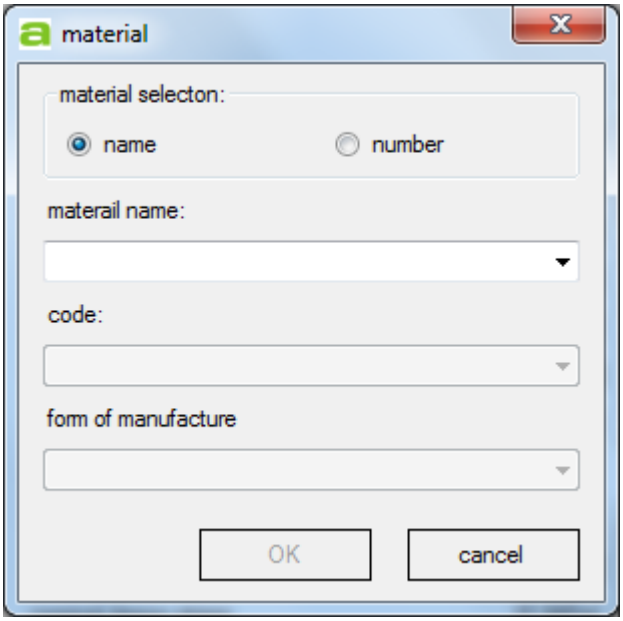
The reading of data is done via the button "read data record" in this mask “gasket material”. If you want to change the source database file for the gasket material you have to do this by clicking the button “create data record”. Select the button “Change” to open a separate input mask for the file selection. After the selection of the file select the button “Close” at the bottom of the mask “Gasket characteristics according to EN 13445” to confirm the selection.

3.4.11 Mask “flange 1 material“

In the input mask "fl. 1 material”, the strength characteristics of the material used for loose flange and flange 1 of the stub/flare can be entered. At the same time you can choose the material for the other flange (flange 2, loose flange 1 / 2) if they are made of a different material. Therefore you must select one of the options in the line "separate material input of:" in the input mask.



The values can be either manually entered or imported into the fields from a database. For this purpose the "code" button is available.



After the selection of the material via material name or number, the code can be defined in a dialog box, and finally you can select the “form of manufacture” in a third dialog box.

As long as you have not changed any of the data from the database, the values are updated automatically when you are changing the temperature of a load condition. This does not happen if you have modified or entered the data manually.

Manual inputs can be stored with the button "save file" and are available for further calculations again. The reading of data is done via the "open file" also on this mask.

3.4.12 Mask “loose flange 1 material“

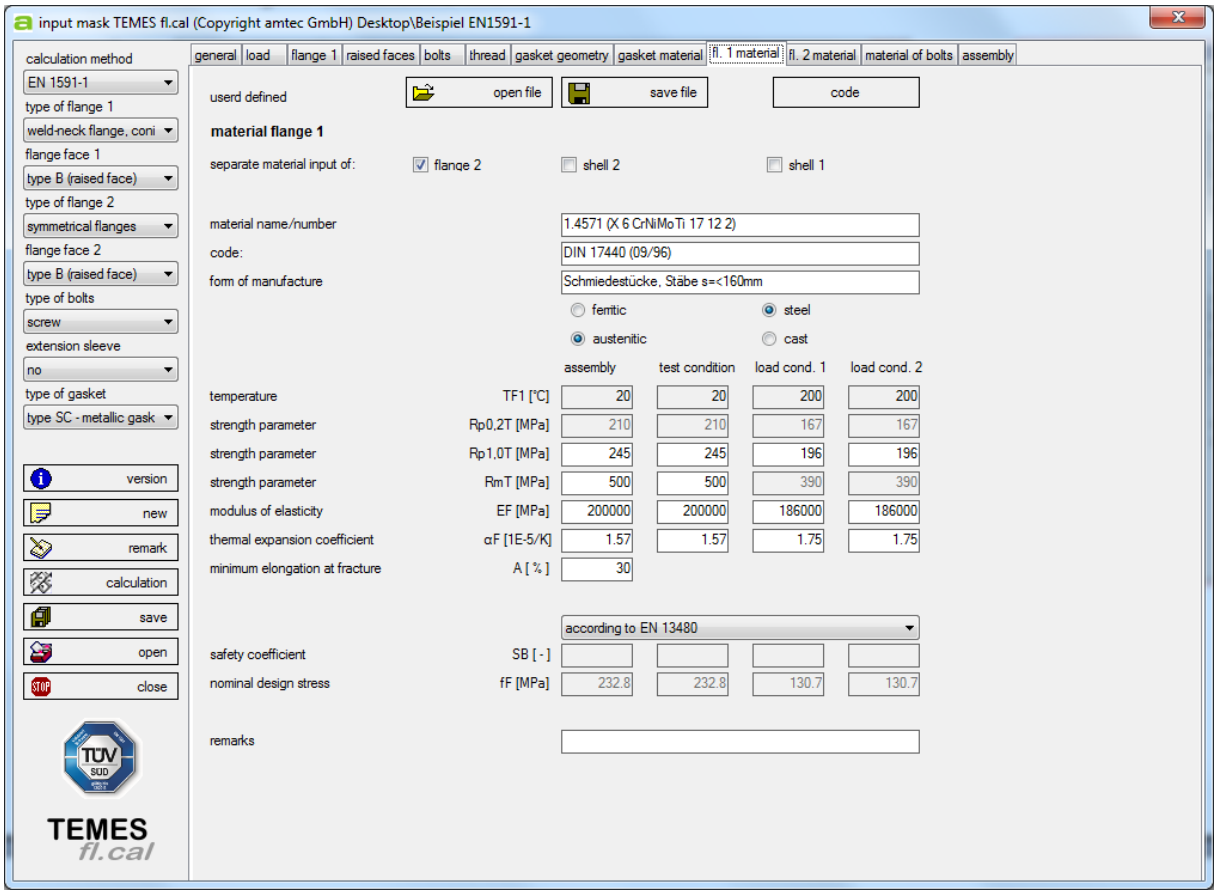
For the material of loose flange 1, there are the same functions available as for the material of flange 1. To enable this input mask for the loose flange 1 you need to activate “separate material input of: loose flange 1" in the mask “fl. 1 material“.

3.4.13 Mask “shell 1“

For the material of shell 1, the same functions as for the material of flange 1 are available. To enable this input mask for shell 1, you need to enable "separate input material of: shell 1" in the mask “fl. 1 material“.

3.4.14 Mask “fl. 2 material“

For the material of flange 2, the same functions as for the material of flange 1 are available. To enable this input mask for flange 2, you need to activate “separate material input of: flange 2" in the mask “fl. 1 material“.



3.4.15 Mask “loose flange 2 material“

For the material of loose flange 2, the same functions as for the material of flange 1 are available. To enable this input mask for the loose flange 2, you need to activate „separate material input of: loose flange 2" in the mask “fl. 1 material“.

3.4.16 Mask “shell 2 material“

For the material of shell 2, the same functions as for the material of flange 1 are available. To enable this input mask for shell 2, you need to enable "Separate input material of: shell 2" in the mask “fl. 2 material“.

3.4.17 Mask “material of bolts“

In the input mask "material of bolts", the strength characteristics of the material can be entered.

It offers the same functionality like the input mask for the material of flange 1.

3.4.18 Mask “material of extension sleeve“

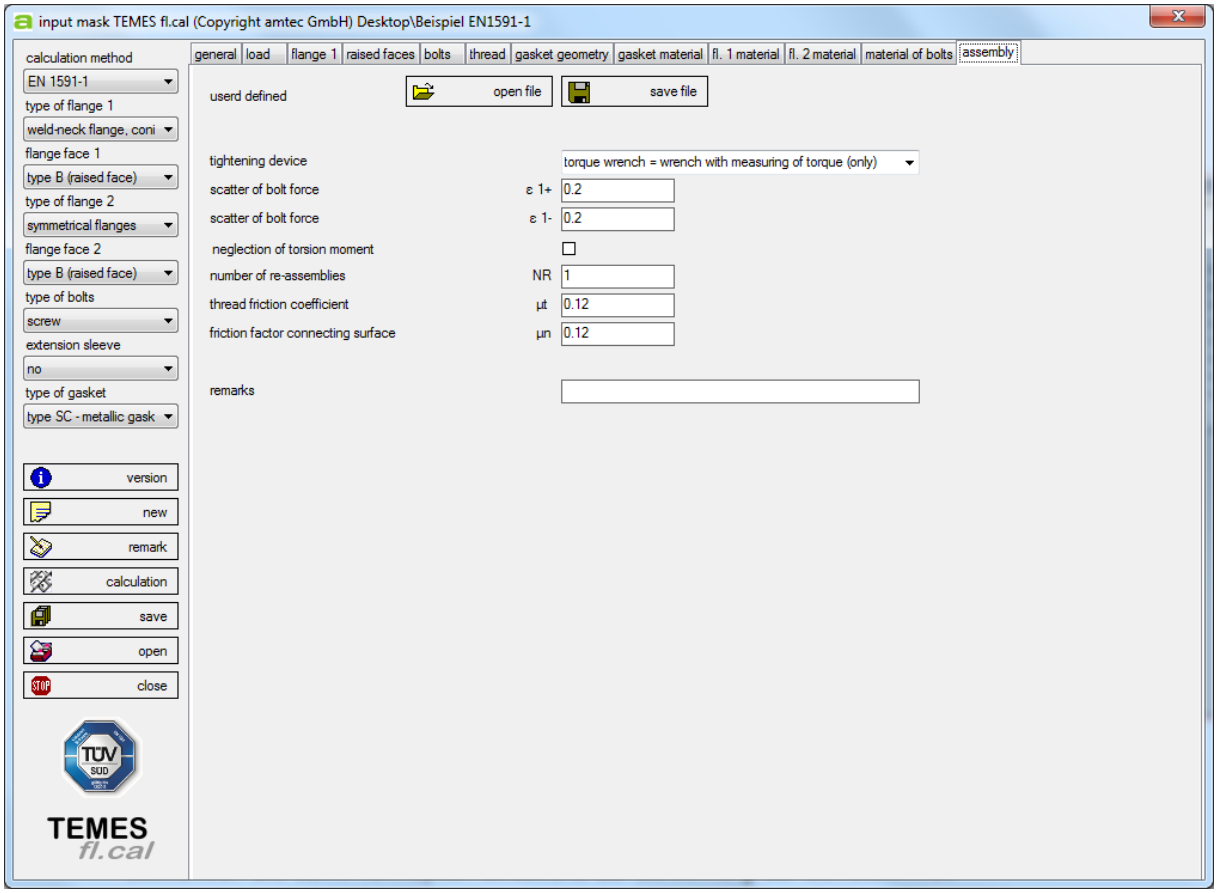
In the input mask "material of extension sleeve", the strength characteristics of the material can be entered.

It offers the same functionality like in the input mask of the material of flange 1.

3.4.19 Mask “assembly“

The last input screen contains the information that is necessary to define the assembly conditions such as tightening device, scatter band of the tightening and friction coefficients. Be aware that if several separate materials are selected for the flanged connection, the tab for selecting the “assembly” input mask might occur in a

second row of tabs above the standard tabs (“general”, “load”, “flange 1”, “raised faces”, “bolts”, “thread”, “gasket geometry”, …).

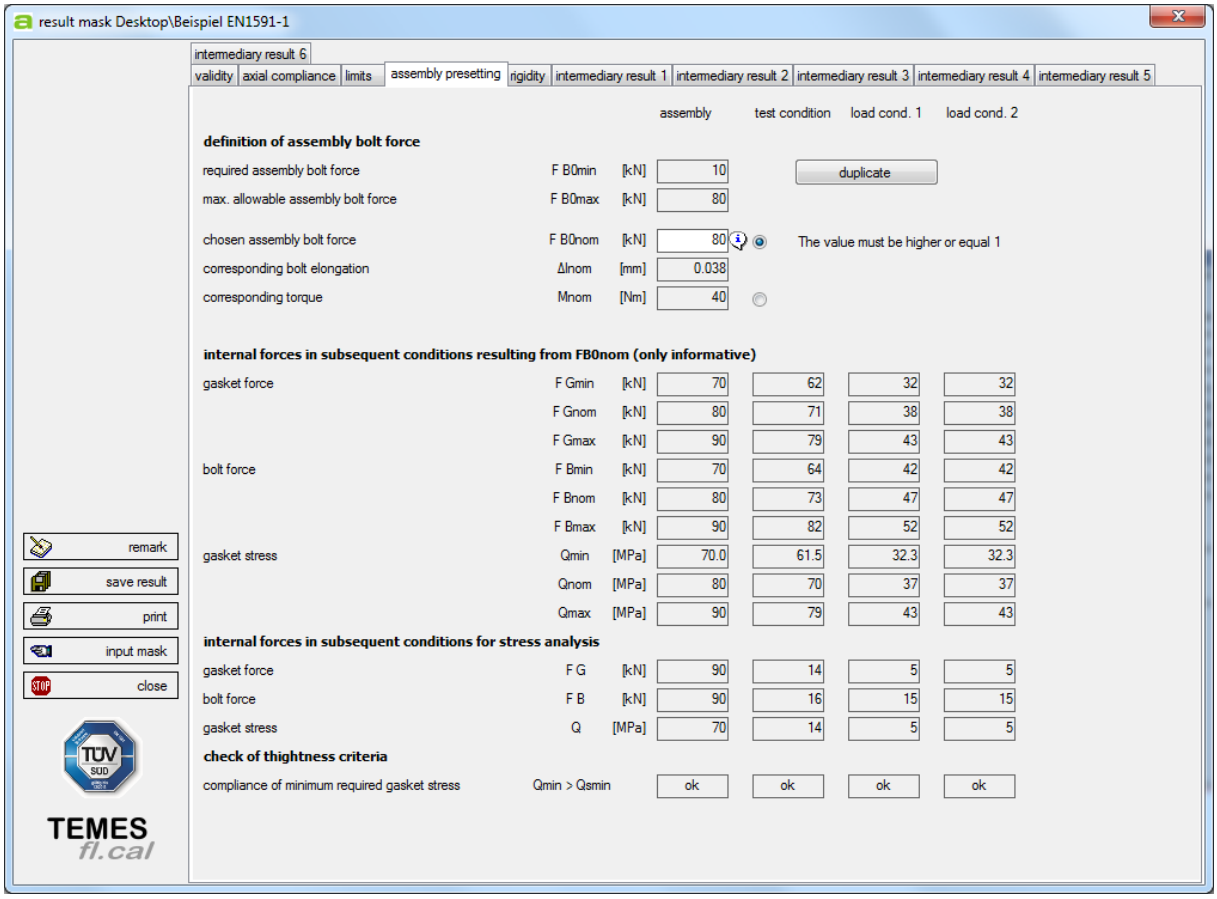


In the input mask "assembly" tightening devices can be selected from a drop down list named “tightening device”. The associated scattering values used to calculate the bolt force are provided in Annex C of EN 1591-1.

Additional tightening devices with other scatter values can be stored as user records with "save file" and are available for further calculations via the button "open file".

3.5 Program module EN 1591 – results

With the “calculation“ button in the lower left area of the user interface window you can start the calculation. If all input data is available, the calculation is performed and the program jumps to the output mask "assembly presetting" in which the required and maximum allowable assembly bolt force are displayed. An automatic suggestion for the “chosen assembly bolt force” is displayed together with the corresponding bolt elongation and torque.


result mask Desktop\Beispiel EN1591-1
intermediary result 6
validity
axial compliance
limits
assembly presetting
rigidity
intermediary result 1
intermediary result 2
intermediary result 3
intermediary result 4
intermediary result 5
assembly
test condition
load cond. 1
load cond. 2
definition of assembly bolt force
required assembly bolt force F B0min [kN] 10
duplicate
max. allowable assembly bolt force F B0max [kN] 80
chosen assembly bolt force F B0nom [kN] 80
The value must be higher or equal 1
corresponding bolt elongation Δlnom [mm] 0.038
corresponding torque Mnom [Nm] 40
internal forces in subsequent conditions resulting from FB0nom (only informative)
gasket force F Gmin [kN] 70 62 32 32
F Gnom [kN] 80 71 38 38
F Gmax [kN] 90 79 43 43
bolt force F Bmin [kN] 70 64 42 42
F Bnom [kN] 80 73 47 47
F Bmax [kN] 90 82 52 52
gasket stress Qmin [MPa] 70.0 61.5 32.3 32.3
Qnom [MPa] 80 70 37 37
Qmax [MPa] 90 79 43 43
internal forces in subsequent conditions for stress analysis
gasket force F G [kN] 90 14 5 5
bolt force F B [kN] 90 16 15 15
gasket stress Q [MPa] 70 14 5 5
check of thightness criteria
compliance of minimum required gasket stress Qmin > Qsmin ok ok ok ok
remark
save result
print
input mask
close
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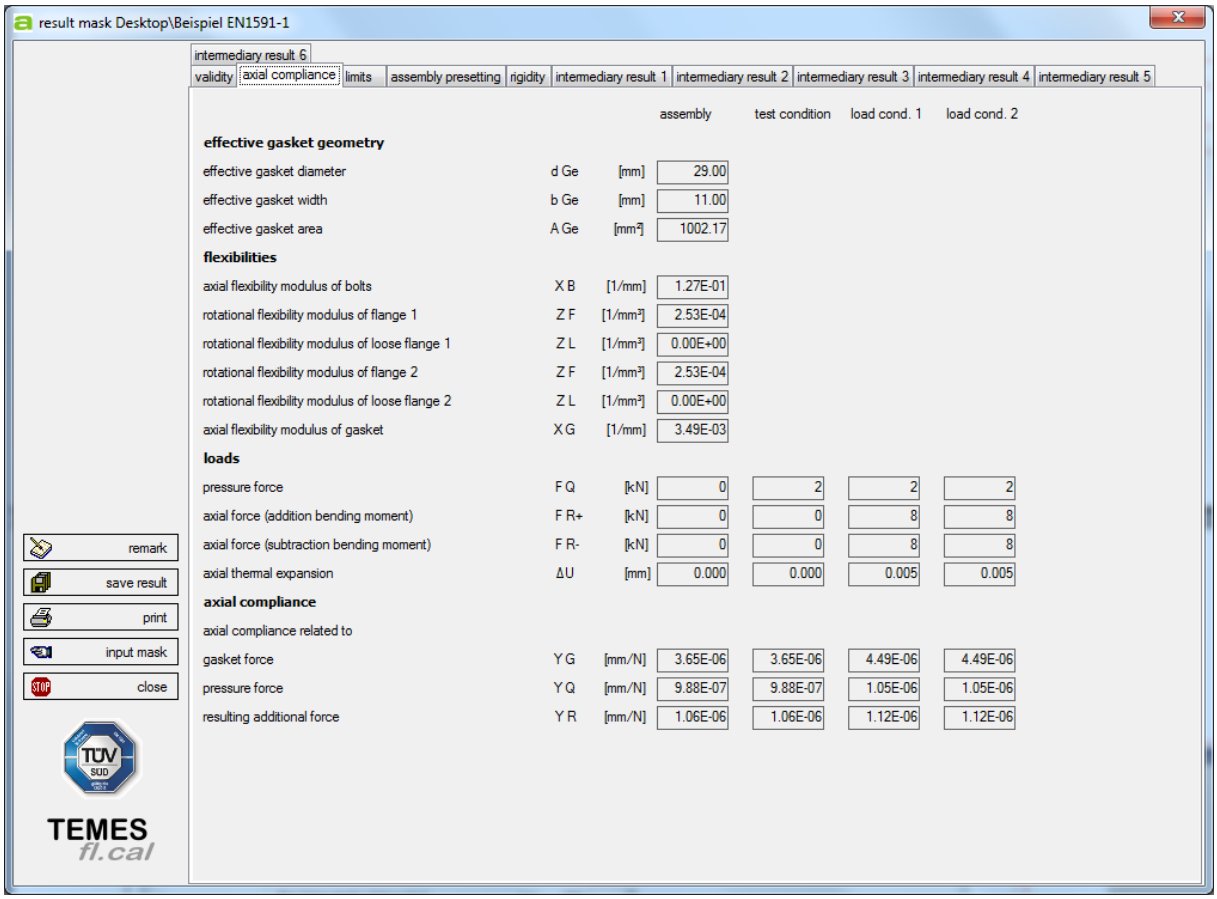
In the header of the results mask multiple tabs appear that give access to various output masks.

The individual result masks are described now:

3.5.1 Mask “axial compliance“

In the mask “axial compliance“, you can see the effective gasket geometry, which results from the flange rotation.

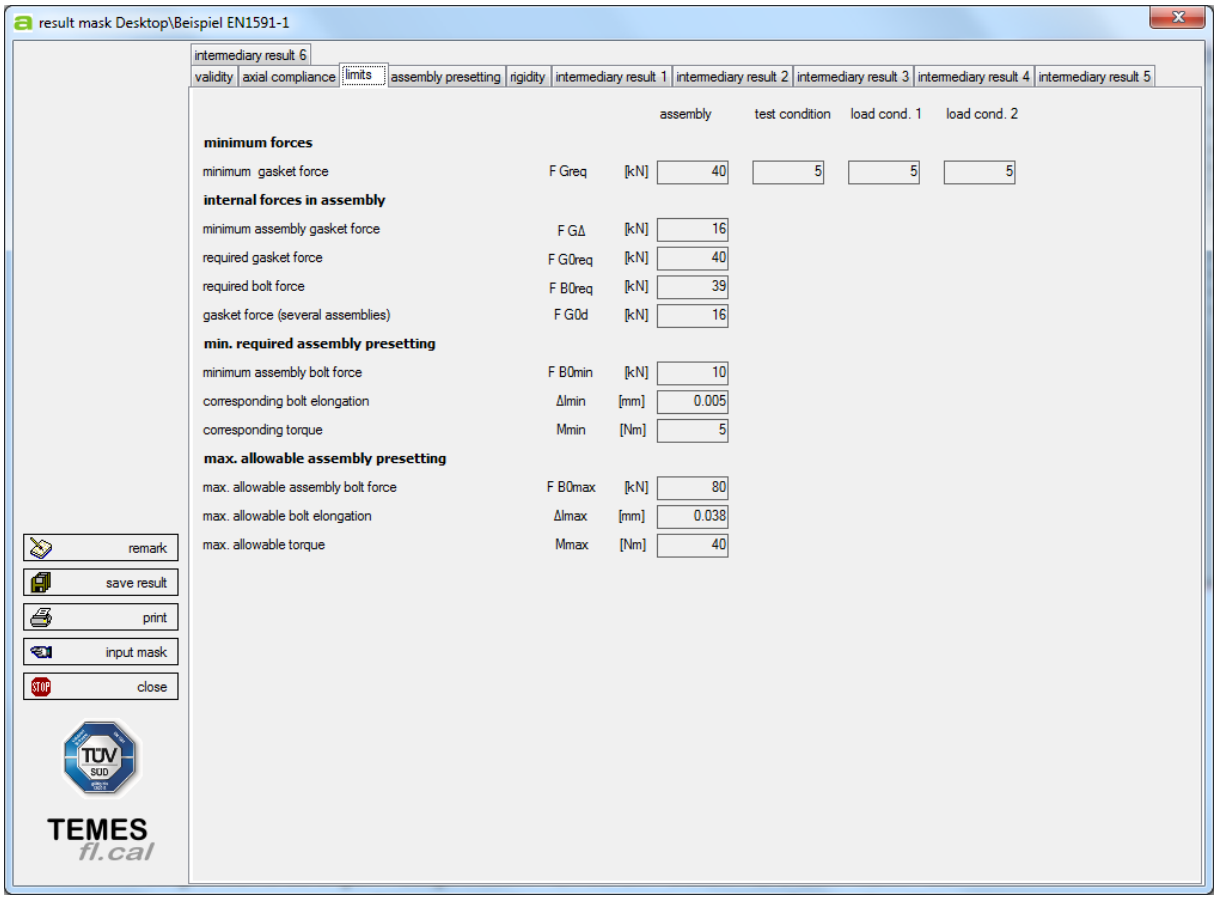
Further results on this mask are the flexibility moduli of the individual components, which are needed to determine the compliances between the various loads. These axial compliances under the loads gasket force, axial force of the medium pressure and external force are also displayed.



			assembly	test condition	load cond. 1	load cond. 2
effective gasket geometry						
effective gasket diameter	d Ge	[mm]	29.00			
effective gasket width	b Ge	[mm]	11.00			
effective gasket area	A Ge	[mm²]	1002.17			
flexibilities						
axial flexibility modulus of bolts	X B	[1/mm]	1.27E-01			
rotational flexibility modulus of flange 1	Z F	[1/mm²]	2.53E-04			
rotational flexibility modulus of loose flange 1	Z L	[1/mm²]	0.00E+00			
rotational flexibility modulus of flange 2	Z F	[1/mm²]	2.53E-04			
rotational flexibility modulus of loose flange 2	Z L	[1/mm²]	0.00E+00			
axial flexibility modulus of gasket	X G	[1/mm]	3.49E-03			
loads						
pressure force	F Q	[kN]	0	2	2	2
axial force (addition bending moment)	F R+	[kN]	0	0	8	8
axial force (subtraction bending moment)	F R-	[kN]	0	0	8	8
axial thermal expansion	ΔU	[mm]	0.000	0.000	0.005	0.005
axial compliance						
axial compliance related to						
gasket force	Y G	[mm/N]	3.65E-06	3.65E-06	4.49E-06	4.49E-06
pressure force	Y Q	[mm/N]	9.88E-07	9.88E-07	1.05E-06	1.05E-06
resulting additional force	Y R	[mm/N]	1.06E-06	1.06E-06	1.12E-06	1.12E-06

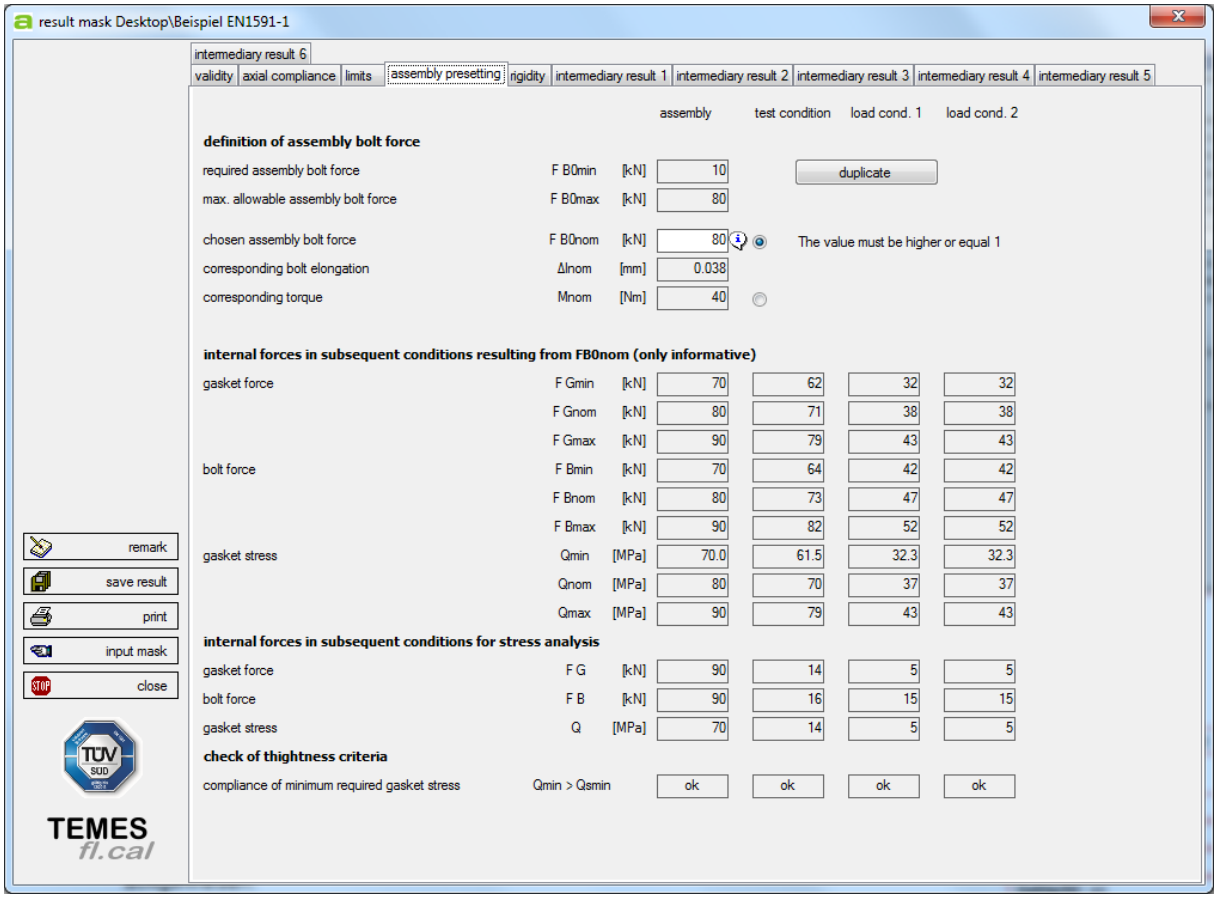
3.5.2 Mask “limits“

In the mask “limits“ the minimum forces are displayed which are necessary to comply with the tightness requirements. These results for each load condition are aimed to assist you in selecting the adequate assembly bolt force without falling below the minimum required gasket stress.



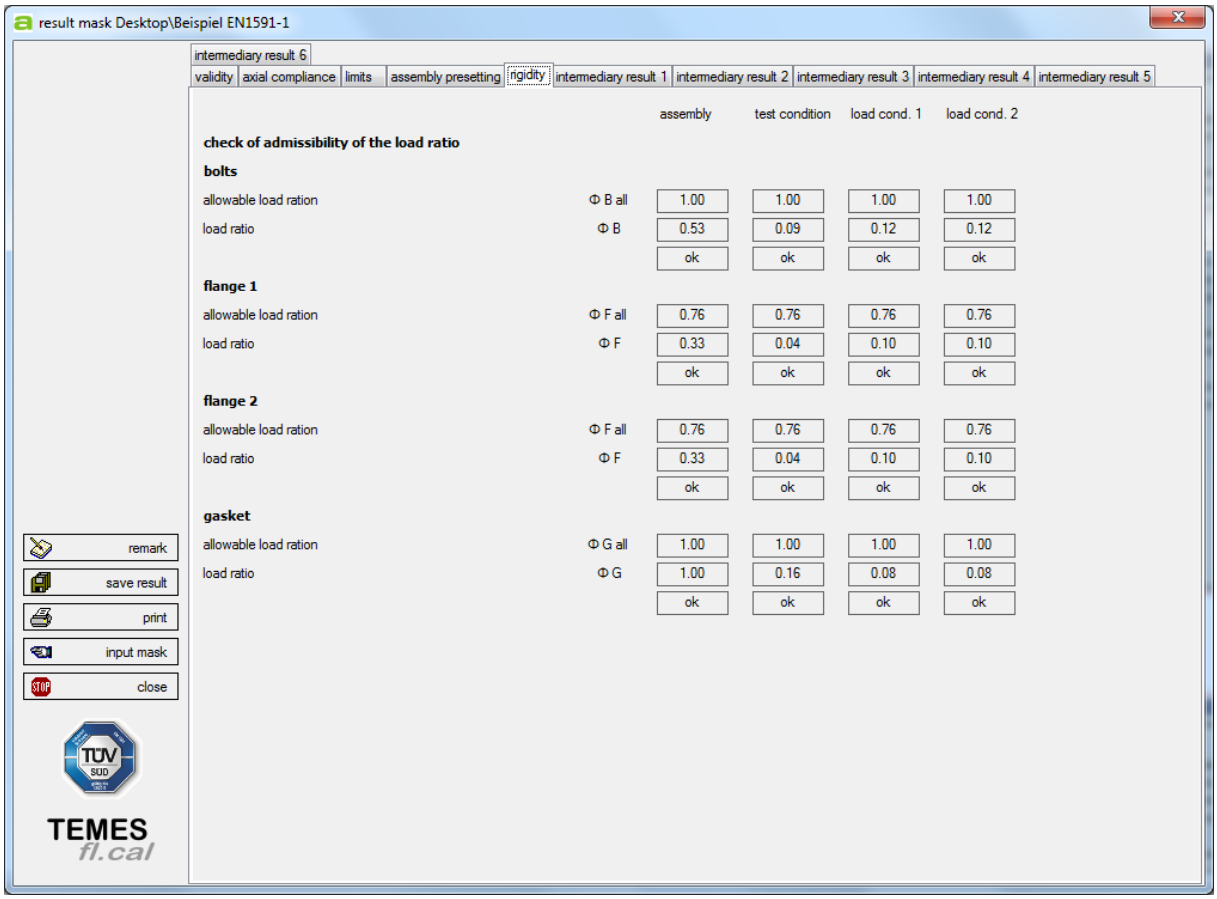
3.5.3 Mask “assembly presetting“

In the mask “assembly presetting”, the required assembly bolt force to maintain the tightness requirements and the maximum force to meet the strength requirements are reported. The user can choose the assembly bolt force in “chosen assembly bolt force”.
Then the corresponding torque and the bolt elongation are shown as default for the assembly of these selected forces. Also the bolt force, the gasket force and the gasket stress are reported for all loads, in each case taking into account the scatter band of tightening.


result mask Desktop\Beispiel EN1591-1
intermediary result 6
validity
axial compliance
limits
assembly presetting
rigidity
intermediary result 1
intermediary result 2
intermediary result 3
intermediary result 4
intermediary result 5
assembly
test condition
load cond. 1
load cond. 2
definition of assembly bolt force
required assembly bolt force F B0min [kN] 10
duplicate
max. allowable assembly bolt force F B0max [kN] 80
chosen assembly bolt force F B0nom [kN] 80
The value must be higher or equal 1
corresponding bolt elongation Δlnom [mm] 0.038
corresponding torque Mnom [Nm] 40
internal forces in subsequent conditions resulting from FB0nom (only informative)
gasket force F Gmin [kN] 70 62 32 32
F Gnom [kN] 80 71 38 38
F Gmax [kN] 90 79 43 43
bolt force F Bmin [kN] 70 64 42 42
F Bnom [kN] 80 73 47 47
F Bmax [kN] 90 82 52 52
gasket stress Qmin [MPa] 70.0 61.5 32.3 32.3
Qnom [MPa] 80 70 37 37
Qmax [MPa] 90 79 43 43
internal forces in subsequent conditions for stress analysis
gasket force F G [kN] 90 14 5 5
bolt force F B [kN] 90 16 15 15
gasket stress Q [MPa] 70 14 5 5
check of thightness criteria
compliance of minimum required gasket stress Qmin > Qsmin ok ok ok ok
remark
save result
print
input mask
close
TEMES fl.cal

3.5.4 Mask “load ratio“

In this mask, the load ratios of the individual components are shown for the selected bolt force under consideration of the scatter band of the tightening device.



4 Appendix

4.1 Priniciples of standard EN 1591-1

refer to:

EN 1591-1
Version April 2001 and Amendment A1, version May 2007